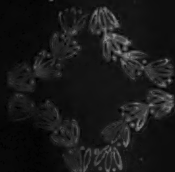


TRANSACTIONS  
AMERICAN FISHERIES  
SOCIETY



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TRANSACTIONS

OF THE

AMERICAN  
FISHERIES SOCIETY

AT ITS

Thirtieth Annual Meeting

JULY 19 AND 20, 1901.

*Headquarters of the Meeting, Hotel Pfister, Milwaukee,  
Wisconsin.*

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APPLETON, WIS.  
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS.  
1901.

## Officers for 1901-1902.

<i>President,</i>	- - -	GENERAL E. E. BRYANT, Madison, Wis.
<i>Vice-President,</i>	- -	EUGENE G. BLACKFORD, New York City.
<i>Recording Secretary,</i>	-	GEORGE F. PEABODY, Appleton, Wis.
<i>Corresponding Secretary,</i>		JOHN E. GUNCKEL, Toledo, Ohio.
<i>Treasurer,</i>	- - -	C. W. WILLARD, Westerly, R. I.



### EXECUTIVE COMMITTEE.

JOHN W. TITCOMB, *Chairman*, St. Johnsbury, Vt.

GEORGE T. MATHEWSON, Thompsonville, Conn.

I. H. DUNLAP, Washington, D. C.

HENRY O'MALLEY, Baker, Wash.

W. H. BOARDMAN, Central Falls, R. I.

J. J. STRANAHAN, Bullochville, Ga.

## NOTE.

On account of the short time at the disposal of the convention, it was impossible to discuss every paper which was contributed. The text of the various papers and discussions will be found in Part Two of the Transactions.



PART I.

BUSINESS SESSIONS.



# Transactions of the American Fisheries Society.

*Friday, July 19, 1901.*

Convention called to order at 10:30 a. m., by the President, Mr. F. B. Dickerson, of Detroit, Mich.

During the several sessions the following gentlemen were elected to membership in the society:

Name.	Address.
Ainsworth, G. G.....	Leadville, Col.
Babcock, John P.....	San Francisco, Cal.
Baldwin, O. N.....	San Marcos, Tex.
Beeman, Henry W.....	New Preston, Conn.
Bennett, Chas.....	Woonsocket, R. I.
Blakeslee, T. J.....	New York City.
Bross, John L.....	Mill Creek, Mich.
Bush, C. P.....	Columbus, Ga.
Clark, Fred.....	Mill Creek, Mich.
Cooper, E. A.....	Cold Spring Harbor, N. Y.
Davis, E. A.....	Bethel, Vt.
Dean, Herbert D.....	Neosho, Mo.
DeNyse, Washington I.....	Gravesend Beach, N. Y.
Frook, John E.....	Paris, Mich.
Fullerton, Samuel F.....	St. Paul, Minn.
Gilmore, Col. Chas.....	Swanton, Vt.
Gortz, A. F.....	Chicago, Ill.
Hulff, J. H.....	Norfolk, Neb.
Jones, Col. James E.....	New York, N. Y.
Kashiwa, A. M.....	New York, N. Y.
Keller, H. N.....	Santa Monica, Cal.
Leary, John L.....	San Marcos, Tex.
Mershon, W. B.....	Saginaw, Mich.
Mitchell, Prof. Irving M.....	Milwaukee, Wis.

*Thirtieth Annual Meeting*

Mitchell, John A.....	Columbus, Ga.
Neal, John R.....	Boston, Mass.
Norman, R. M.....	Columbus, Ga.
Parker, W. H.....	Lac la Pêche, Quebec, Canada.
Pike, Robert G.....	Middletown, Conn.
Sampson, E. R.....	New York, N. Y.
Sanborn, F. G.....	San Francisco, Cal.
Scarborough, L. A.....	Columbus, Ga.
Schley, Dr. F. V.....	Columbus, Ga.
Schulte, John A.....	Havana, Ill.
Singleton, James H.....	Woonsocket, R. I.
Smith, Henry D.....	Appleton, Wis.
Smith, Jay.....	Boston, Mass.
Snyder, Dr. F. B.....	Ashtabula, Ohio.
Spencer, L. B.....	New York, N. Y.
Springer, F. H.....	Columbus, Ga.
Suthers, Frank.....	Madison, Wis.
Townsend, Chas. H.....	Washington, D. C.
Turner, J. C.....	Columbus, Ga.
Wentworth, Edwin.....	Nashua, N. H.
Wheeler, Chas. Stetson.....	San Francisco, Cal.
Wisner, J. Nelson, Jr.....	Washington, D. C.
Woodruff, C. B.....	Columbus, Ga.

**Honorary membership.**

Peck, Hon. Geo. W.....	Milwaukee, Wis.
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The President: It affords me much pleasure to greet the members of this Association on this our 30th annual gathering. I had hoped however to see a great many more present, but understand that there will be quite a good many more here this afternoon. I must confess that I have been so very busy during the past year that I have not done a very great deal of work myself; the secretary however has done a great deal.

We are assembled for educational purposes with as much in the line of social intercourse and good fellowship as we can crowd in on the side. I am afraid however that we will not have an opportunity to crowd in very much "on the side," inasmuch as our gathering a year ago must have been composed largely of Seventh Day Adventists, as they set this meeting so that if we consume the three days we would have to work on Sunday, the

same as they do. The consequences are that this year we will have to crowd three days' work into two or desecrate the Sabbath; so we must get right down to business and hurry along.

I understand that we have two illustrated lectures which of course will be very interesting, and if it is possible to have both of those tonight we will do so, inasmuch as it is desired to go to the Bayfield Hatchery tomorrow on the early evening train, and therefore there will be no opportunity for any session tomorrow night.

I love to fish as well as any man living. In fact, for me this form of recreation ranks above all others and claims all of the time I can possibly steal from a very busy life to devote to real and unalloyed pleasure. I would like to be wading and whipping a good trout stream this very moment; or be in camp near the banks, under the inspiration of the woods and God's pure air, and within sight of familiar pools and bends where the skillful dropping of a fly would not pass unrewarded. In the midst of such surroundings, gentlemen—and if any of you haven't been right there, you have missed the best opportunity of your life—I might warm up and talk of fish and fishing by the hour, of the big trout I have landed and of the still bigger ones that got away, but time forbids.

A word as to the growth of our society and the qualifications for membership. It seems to me that our membership list should increase far more rapidly. We should have one hundred members or even one thousand where we now have but one. It has occurred to me that through lack of example or proper encouragement, we have unintentionally barred out a large class who are eminently qualified for admission, and I hereby appoint every member a committee of one to advertise the fact that all amateur and professional fish liars are eligible to membership. No convention hall in the country would hold the delegates if we could but bring into the fold all who are gifted in this direction and practice the art. Indeed, from some things I have heard since coming here, there is a lot of mighty good material in Milwaukee, and we should at least double our membership right here.

On my way over, the thought occurred to me that, although we are now few in numbers, this organization is destined to grow

great and powerful. We are the pioneers in a movement that must inevitably exert a far-reaching influence and become an important factor in the solution of the greatest economic problem that must sooner or later confront mankind, namely, that of providing an abundant and unfailing source of food supply. And why? In this and nearly all countries we find that practically all fertile lands, lands that yield their fullest fruitage merely by tickling the soil, are occupied. Increased food production from this direction must come very largely through fertilization, irrigation, and more thorough and scientific methods of farming.

But we have an immense area of inland and outlying waters, constituting a water farm of such vast proportions and possibilities, that it can be cultivated only by states and nations. This great public farm, this vast public estate, is today very largely in a state of nature, uncultivated, unexplored, unexploited. True, great progress in the science and art of producing water life has been made in this country, greater, in fact, than by all other nations combined, resulting in the creation of millions of dollars in food wealth, yet we are only at the threshold of the possibilities in this direction. And it is the mission of this society collectively, as it should be of every member individually, to aid in discovering and pointing out the way to so cultivate and crop this vast water farm as to develop its illimitable resources to the greatest practicable limit. We are charged with a high responsibility, gentlemen, but we are engaged in a noble cause, and if we are but true to our mission, each contributing his mite towards the solution of the complex problem before us, we shall be true to humanity, and millions yet unborn will rise up to bless the name and the founders and pioneers of the American Fisheries Society.

(Applause).

We will vary our program as we have really less than two days in which to do the work of three, and will therefore have to rush matters with all possible speed. With the permission of those present I will forego the appointment of committees until this afternoon, as I understand there are more members to arrive about noon. Just exactly what the program is as regards the desires of the Wisconsin Fish Commission, I am not fully in-

formed; the only thing I know of is their generous invitation, without expense, to take this body of gentlemen to the Bayfield Hatchery; I understand they have furnished a private car to be attached to the regular train. Every one who can should avail himself of this invitation and visit the Bayfield Hatchery, which is a most excellent one in every respect.

A motion was carried that the president appoint a temporary treasurer to take the place of the treasurer in his absence.

The president appointed Mr. I. H. Dunlap of the United States Fish Commission, Washington, D. C., as temporary treasurer.

The President: I will appoint as a committee on new members, to report as soon as possible, Mr. Frank N. Clark, of Northville, Mich., Mr. George F. Peabody, of Appleton, Wis., and Mr. I. H. Dunlap.

General E. E. Bryant, of Madison, then read a paper on the subject of "The Power of the State to Regulate Fisheries and the Taking of Fish."

Mr. Henry T. Root, Providence, R. I.: That is a paper which I think should be published by the society and distributed largely to the members, without waiting for it to appear in our regular transactions. It is the most valuable paper probably ever prepared on this subject, and we ought to have it printed in such quantities that we can lay it before different legislators. I should like to bring up a motion that will cover that point.

Mr. Titcomb: I would like to put it in as an appendix to our state report if we could get it.

The President: It could be printed readily and cheaply by the society.

Mr. Root: I move that a thousand copies of the paper read by Gen. Bryant be printed at the expense of the society and distributed to the members.

The President: Our commission will print five thousand and charge any other state that wants them a proportionate rate and it won't cost the society anything. It ought not to cost over two dollars a thousand to print the paper.

It was moved by Mr. Henry T. Root that the president, Mr.

Dickerson, be requested to print 5,000 copies of General Bryant's paper and to supply them to other commissions at cost price.

Motion seconded and unanimously carried.

Dr. J. C. Parker, of Grand Rapids, Mich., then read a paper on the subject of "Man as a Controlling Factor in Aquatic Life."

Mr. John E. Gunckel, of Toledo, O., then read a paper entitled, "The Index."

The President: There will be two lectures this evening, commencing at 8 o'clock, one by Mr. Titcomb, illustrating propagation of fish, and the other by Mr. Townsend, on deep sea soundings. These lectures will be illustrated with lantern slides and the public are invited to attend them.

Recess until 2:30 p. m., same day and place.

AFTERNOON SESSION, JULY 19.

Society called to order by the president, at 2:55.

The President: We will first hear the report of the committee on new members.

Mr. Clark: The committee have had these names under consideration, which have all been recommended by members of the society. They are all good men and true, and we are glad to have them join.

(List of new members read, whose names are published at the beginning of the printed proceedings, together with those of all others admitted during the several sessions).

They have all paid the annual dues of \$1.00 to the secretary and your committee recommend them for membership in this society and that they be elected as members of this society with all its privileges.

Report adopted and members elected.

Moved, seconded and unanimously carried that the chair appoint the usual committees.

The President: I will appoint as the committee on nominations: George F. Peabody, Henry T. Root, J. J. Hogan, Frank N. Clark and John W. Titcomb.

Auditing committee: I. H. Dunlap, D. Lydell and W. F. Hubbard.

Committee on time and place of next meeting: J. E. Gunkel, G. M. Brown and W. H. Boardman.

Committee on resolutions: General E. E. Bryant, Charles H. Townsend and S. W. Downing.

Report of treasurer referred to auditing committee.

The President: The committees will report tomorrow morning.

You will remember that there was a memorial committee appointed to consider the plan of erecting a memorial to Professor Baird, and the chairman of that committee being unavoidably absent has submitted his report and I will request Mr. Clark to read it.

Mr. Clark then read the following:

REPORT OF BAIRD MEMORIAL COMMITTEE.

Woods Hole, Mass., July 13, 1901.

To the President,

American Fisheries Society,

Milwaukee, Wis.

Sir:—As chairman of the Baird memorial committee appointed at the last meeting of the society, I have the honor to make the following brief report:

Shortly after the adjournment of the society, the committee set about soliciting subscriptions, by means of letters and personal appeals, and invited small contributions from many rather than large contributions from a few. The plan to erect at Woods Hole a memorial to Professor Baird was favorably noticed in the press and unqualifiedly endorsed by the fishing and scientific public.

From a statement furnished by the treasurer, Hon. E. G. Blackford, it appears that the total amount subscribed up to July 15, 1901, was \$503.25, of which \$473.25 had been paid and \$30.00 remained unpaid. This sum has been contributed in small amounts by many persons, the largest individual subscriptions being \$20.00.

At a called meeting of the committee held at Washington on February 3, it was decided, after considering the probable amount of the subscriptions, that the proposed memorial take the form of a natural boulder with suitably inscribed artistic

bronze tablet; and full powers for determining the details and proceeding with the erection of the monument were delegated to a sub-committee consisting of the chairman and treasurer.

Various unavoidable matters have delayed the completion of the monument more than the committee anticipated; but it can now be stated that the plans for the monument have been completed, the placing of the stone will soon be begun, and the memorial will be duly consummated during the present summer.

Respectfully submitted,

H. M. SMITH.

A motion was then made, seconded and unanimously carried that the report be received and referred to committee on resolutions.

General Bryant: Is there any member of the memorial committee present to whom we can hand contributions?

The President: Mr. Peabody and Mr. Clark are members of the committee and are present.

I think it will be well, in view of the limited time we have, to first listen to those papers furnished by members who are here themselves to read them, and then we can take up those papers which are to be read by others, because there are undoubtedly a number of them that we will simply have to print in the proceedings, so that if there is no objection we will go ahead and call on those who are present first to read their papers.

The Wisconsin commission would like to know exactly how many gentlemen are going tomorrow night to Bayfield. The transportation is furnished and those who go will simply pay for their sleeper. The train will return Monday morning and will reach Chicago at 9 o'clock. The Bayfield Hatchery of course is one of the latest and most up-to-date hatcheries in the country, and is well worth a visit.

Professor Marsh then read a paper on the subject of "Brook Trout Disease."

General Bryant: We have among us now ex-Governor George W. Peck, of Wisconsin. He is a friend of the fish and game commission, and I would like to suspend our discussion for a moment, if this paper is concluded, and hear a few words from him.

The President: He is a bad boy and something of a fisherman himself, and that is why I know he is a bad boy. He said to me this morning, "Dickerson, did you ever know of a fish called the bee-fish?" I said no, I had never heard of him, and he went on to tell about fishing off the dock down here at Milwaukee and he said he caught one of those bee-fish and it weighed seventeen pounds and when he got him on the dock and cut him open he found a hive of bees in him and thirty-two pounds of honey. I think he is eligible.

(Great laughter and applause).

Ex-Governor Peck: I had supposed that the Fish Commissioners were the ones that told those stories. Before Fish Commissions were appointed the laymen who do the fishing were supposed to tell those remarkable stories, but as I understand it, the appointment of these Fish Commissioners was made for the purpose of having them start out and tell the stories that the people might adopt. That certainly was my idea in appointing two of the most distinguished citizens of Wisconsin as Fish Commissioners. (Laughter and applause).

I have been interested in fish since I was seven years old. At that time I was provided with a three board boat that would hold a barrel of water to wade in, and I had my trousers rolled up, what there was of them, and I caught the sunfish and the bullhead. That was my first experience, and I have great confidence in the bullhead because he never goes back on the fisherman. When a bullhead bites you have got him; you haven't got to fool away any time with a three ounce rod in poling him all over the lake or river to get him into your boat. When he begins business and swallows the bait it goes clear down to the bottom and the best way is to cut it out from the other side. (Laughter). The bullhead is the best thing that a young man can begin on, because it teaches him that the fisherman is invulnerable and the bullhead is a fool. But the bullhead is good eating. After that I caught all kinds of fish that I could; I never worked any when I could help it and never shall (laughter and applause). I believe that it is the duty of every citizen of Wisconsin particularly to go fishing all of the time that he can. Business is something that some have to attend to, but when men get to be 50 or

60 years old the business should be attended to by their sons, or their sons-in-law, and men should be allowed to go fishing.

Not many years ago I advocated publicly in the newspapers that when old men were sent to asylums or poor houses or soldiers' homes, those institutions ought to be located upon the bank of some lake or river where there is fishing, and every old man after he gets to be 60 should be provided with a boat and all the fishing tackle that he wants, and that the city or the county that entertains him as a pauper or in any other capacity, should give him the bait, and if it is necessary, if he has had his finger shot off, somebody should be detailed to put the bait on the hook for him. That is the way I feel about the old men. Old women can get along any way—all they want is to eat the fish.

I presume many of you do not know much about Wisconsin except what you have been told by our local manufacturers. If you could see a map of the northern part of the state you would think that Wisconsin was one case of smallpox from the number of little lakes dotted all over it; and these clear lakes, some of them not more than half a mile across, are full of the best fish in the world. The waters are deep, blue, perfect and clean, and you ought to go into the northern part of the state for a month and look this business over, look at the fish hatcheries and also look at what nature has done—and nature will keep it up.

You have got a great responsibility. It has sometimes seemed to me that it was wrong to take a female fish, and take all there is in her out and let the Fish Commissioners make it into minnows. I don't know how they do it. I sometimes thought I would go and examine and see how they take this spawn that is no good in the fish, get in their work on it and make it so that it is good. (Laughter and applause). At one time I thought when I appointed some of these Fish Commissioners and we provided through Speaker Hogan a car that would carry fish all over the world, that some time I might get in there and look it over and find out how it was done. I hope that I may do so even yet and that I may be able to work it in in my own business (laughter and applause).

When I read that the Fish Commissioners of a state plant millions upon millions of fish in its waters, I feel as though they are responsible for the millions and millions of lies that will

be told by the fishermen after the fish get big enough to be caught. But a good commissioner does not care how much anybody else lies as long as he is truly good and can tell the truth himself.

I hope that you will visit as much of the state as possible before you go, you will find much good fishing and you will become convinced that Wisconsin is as grand a state as there is in the Union. We raise everything in Wisconsin that is raised anywhere in the world, except h—l. (Laughter and applause). Some of you can do that better than we can. But Wisconsin has got everything from the south line to Lake Superior that the people need for a good living. We could build a fence around the state of Wisconsin and never a citizen go outside of that fence, and nobody be allowed to come in from the outside, and we would all get so fat and so happy that you would pay an admission fee to come and look over the fence and see the good people of the State of Wisconsin. (Laughter). We trust that you may come often to see us, and I will say that I will detail my Fish Commission which is here and which I am as proud of as I am of the appointment of any individuals during my term of office, to greet you and show you everything there is and give you everything that you need to be happy. (Applause).

Mr. Bower: I move that Ex-Governor George W. Peck be elected an honorary member of this society. Motion seconded and unanimously carried.

The President: We shall expect you to be present at our next meeting.

Ex-Governor Peck: I shall if I can. I shall be glad to render any assistance that I can, as long as I live, to the Fish Commission of this country.

The President: While at first it was thought best only to have papers prepared by members present read, yet we have a paper in the same line as that of the preceding paper written by one of the oldest employes of the United States Fish Commission, and it seems to me that this is an opportune time to hear that particular paper. So if there is no objection we will vary the routine a little and I will ask Mr. Bower to read Mr. Charles G. Atkins' paper on the subject of the "Study of Fish Diseases."

The paper was then read by the secretary.

General Bryant here took the chair.

Mr. Sykes then read a paper by Mr. Nevin on the subject of "Muscallonge."

The President: Professor Starr of the Wisconsin Commission has a beautiful yacht and he tenders us a ride on the lake at 5 o'clock this afternoon.

(Invitation accepted).

Motion made at 4:45 p. m. to adjourn until 8 p. m. in the banquet room.

Motion carried.

EVENING SESSION, BANQUET ROOM, 8 O'CLOCK.

Lectures delivered with illustrated lantern slides by Mr. C. H. Townsend on "Deep Sea Exploration," and Mr. J. W. Titcomb on the subject of the "Propagation of Fish."

An adjournment was then taken until July 20th, 10 a. m. in the club room.

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*Saturday, July 20, 1901.*

MORNING SESSION, 10 O'CLOCK.

An invitation was accepted for a carriage ride around the city at 4:30 p. m.

The committee on location and time presented the following report:

REPORT OF COMMITTEE ON LOCATION AND TIME.

After carefully considering the invitations from the several cities we respectfully suggest that the next annual meeting be held at Put-in-Bay (Lake Erie) Ohio, on Tuesday, Wednesday and Thursday of the first week in August, 1902, and that the meeting be called to order at 2 p. m. Tuesday. It is further suggested that the place and time be printed on the letter heads usually furnished by the society.

J. E. GUNCKEL,  
G. M. BROWN,  
W. H. BOARDMAN.

Report received, accepted and unanimously adopted.

Report of committee on nomination of officers, presented by Mr. Peabody:

REPORT OF COMMITTEE ON NOMINATIONS.

The committee on nominations beg to report, nominating the following officers of the society for the ensuing year:

President, General E. E. Bryant, Madison, Wis.

Vice President, Eugene G. Blackford, New York.

Recording Secretary, George F. Peabody, Appleton, Wis.

Corresponding Secretary, John E. Gunckel, Toledo, O.

Treasurer, C. W. Willard, Westerly, R. I.

Chairman Executive Committee, John W. Titcomb, St. Johnsbury, Vt.

Members of Executive Committee: George T. Mathewson, Thompsonville, Conn. I. H. Dunlap, Washington, D. C. Henry O'Malley, Baker, Wash. W. H. Boardman, Central Falls, R. I. J. J. Stranahan, Bullochville, Ga.

Report unanimously accepted, adopted and nominees declared duly elected.

General Bryant, president-elect was called on for a speech.

General Bryant: In the language of our daughters when they are proposed to, I say, "This is so sudden." I had not thought of anything of the kind, but I extend to you my heartiest thanks for your kind appreciation and assure you that in so far as in me lies I will endeavor to serve the society faithfully and promote its interests to the best of my ability. The rest of the oath of office you will consider implied.

The subject of fish culture with me is of necessity more a by-study than a pursuit to which I can give my undivided devotion, but I am very much like old Ethan Allen, of Green Mountain memory, who said that of "all the Lord's cattle on the thousand hills he best preferred soldiers for companions." I can paraphrase that honestly and say that of all the Lord's cattle on a thousand hills I best enjoy the society of men engaged in fisheries and fish culture, and can co-work with them in my feeble way with hearty satisfaction. It is the tendency of human nature, we know, for every man to exalt his own vocation. That

idea comes down to us from the classics in the old adage, "There is nothing like leather." The story is told that when an ancient city was threatened with attack from the enemy, they called a counsel of all the people of the city to consider how they would best fortify it. The stone masons said with a sneer that of course they must use stone; the brickmakers said that by laying brick walls thick enough they would better stand the battering ram than stone; the lumberman insisted that a strong system of stockades would be built the quickest and would best withstand attack. They called up the old tanner and he said, "Gentlemen, there is nothing like leather; you just peg down sole leather walls around this city and all the battering rams on earth cannot batter them down." Every man exalts his own vocation, but we who are engaged in fish culture are in no danger of overdoing. The work that we are doing is so beneficial to mankind, its possibilities so great, its power of usefulness to mankind so unlimited, that we may well exercise this failing of human nature and give to our pursuit due honor. It has been said that the man who makes two blades of grass to grow where one had grown before, is a benefactor of mankind. If that be so how much more is it so where one makes an hundred food-fish to grow where nature makes only one to grow.

You recollect our old friend Sam Weller, one of the most delightful characters that Dickens ever drew, having assisted a young couple to elope, who were very anxious to marry but met with domestic opposition, said, when he was complimented on the part he had taken in the matter, "Well, I only assisted nature." (Laughter). Now we are assisting nature in this work in one of her weak spots. We are taking up her work and producing vastly greater results than she could produce herself. That is our function in this great work, to assist nature and to enable her to produce blessings for mankind an hundred fold or a thousand fold, where left to herself she could give perhaps but five or ten fold. Is not that so, Brother Titcomb?

Mr. Titcomb: That is right.

General Bryant: Let us go on then with this work, let us maintain this society. This society may not present such a showing in numbers at its conventions as the Elks, the Modern Woodmen, or other fraternal societies, but I can liken it best to

those old bottles of wine that have grown few and scarce in a cellar, of some ancient vintage, rich, mellow, delicious and nourishing—but the bottles are few. We have a small membership in attendance, but a large membership in sympathy, a large circle of readers who read with interest the papers that are submitted here. Let us keep up this work. Let us make the report of this society year by year, better and better. Let us dig deeper into all the problems that perplex us. I hope a hundred years from now the American Society of Fisheries will be presenting its annual report and turn back reverently and gratefully to the sterling spirits who worked for it in its youth and its earlier manhood. So far as I can help in my feeble way I promise you my best endeavors. (Applause).

Mr. Gunckel: As I am compelled to take my leave now, I wish to take the liberty, not being a scientist in the art of fish culture, to thank the members for their kindness and personal attention to a common, every day, worm fisherman. I have been a member of the society for eleven years and seldom miss a meeting. Near my home in Toledo some time ago a 21 pound small mouthed bass was caught and turned over to Mr. Downing, of Put-in-Bay, the fish commissioner of the state of Ohio, who is here present. When this fish was taken to him, he opened it and found one gallon of small mouthed black bass eggs. He took those eggs over to his hatchery; he took from his laboratory different bottles of milt procured from various kinds of fishes; he poured this milt in sections over the eggs that he had and in this manner produced pickerel, white-fish, black bass and sun-fish. When you come to Put-in-Bay you can see that hatchery, and I hope to be there to further continue truthful fish stories. (Applause).

Mr. Peabody: I am informed by Mr. Gunckel that his wife secured six gold fish during the present hot season and put them into a globe bowl of water, and they perspired so that the water ran over the edge of the bowl and spoiled the carpet. (Laughter).

The report of the treasurer was then read by Mr. Dunlap.

*Thirtieth Annual Meeting*

## REPORT OF THE TREASURER.

To the American Fisheries Society.

Gentlemen:—I hereby submit my annual report as treasurer, from July 19, 1900, to July 18, 1901.

## RECEIPTS.

July 19, 1900.	To balance in treasury.....	\$216.34
	Yearly dues and fees.....	260.00
	One life membership fee.....	15.00
	Reports sold .....	4.75
	Interest on funds deposited in bank.....	2.71
		<hr/> \$498.80

## DISBURSEMENTS.

July, 1900.	Stenographer, Woods Hole meeting.....	\$ 30.00
	L. D. Huntington, stamps, etc.....	.32
Aug. 10,	Express on treasurer's books.....	.70
21,	J. W. Titcomb, sundries, Woods Hole meeting	7.17
	H. J. Rice, balance due on work.....	54.37
29,	Stamps and envelopes.....	4.50
Sept. 4,	Receipt book .....	2.89
Nov. 30,	Stamps and envelopes.....	4.65
Dec. 18,	Speaker Printing Co., printing, etc.....	162.20
	Richmond & Backus, envelopes.....	4.00
	S. Bower, secretary, stamps, etc.....	30.61
May 10, 1901.	Receipts, stamps and envelopes.....	2.80
July 12,	Speaker Printing Co., circulars, etc.....	15.00
	S. Bower, secretary, stamps, etc.....	13.30
15,	Stamps, envelopes, etc.....	1.20
		<hr/> \$333.71
	Balance on hand.....	165.09
		<hr/> \$498.80

Depository of Funds,

Manufacturers' Trust Co., of Providence, R. I.,  
drawing interest at 2 per cent. subject to check.

CHAS. W. WILLARD,

Treasurer.

July 15, 1901.

## REPORT OF AUDITING COMMITTEE.

Mr. Dunlap: The auditing committee has been over the accounts and finds vouchers except for immaterial expenditures and that the accounts are correct.

Report of treasurer accepted.

Report of auditing committee accepted and adopted.

Mr. Clark: I desire to call attention to the fact that for some reason the balance this year is less than it was last year. I presume that our expenditures have been greater.

Mr. Titcomb: A year ago we made an unusual effort to get in back dues. Members who had not paid for ten or fifteen years were written to, and we got a good many of them to pay up, and for that reason I think our receipts that year were larger than they were this year.

Mr. Clark: I notice in the report of the treasurer that there was one life membership taken out and paid for. I believe that we took action on the subject of life memberships last year, but I think some plan should be adopted so that the life member may have some sort of certificate to show his membership.

The President: I will ask Mr. Boardman to read Professor A. D. Mead's paper on "Experiments in Lobster Culture."

Mr. Boardman: This paper by Dr. Mead, of Rhode Island, deals exclusively with lobsters, and may not be very interesting to those who are not engaged in that culture. Dr. Mead wished me to express his regret at his inability to be present at the meeting, but his work is especially heavy at this time of the year and it was impossible for him to come.

Dr. Mead's paper was then read.

A paper on the subject of "Practical Hints on Fish Culture," by Dr. James A. Henshall, was next read by the president.

Mr. Clark then read a paper entitled, "The Quality of the Water a Factor in Rearing Trout Fry," by Mr. C. C. Wood.

The President: I wish to announce to you all a new arrival, Mr. Carp—I mean Mr. Bartlett. (Laughter). (Mr. Bartlett was invited to address the society).

Dr. S. P. Bartlett, Quincy, Ill.: I thank you.

Mr. Townsend: There is no fish but carp and Bartlett is its prophet.

Dr. Bartlett then addressed the convention.

A motion was made, seconded and unanimously carried that Dr. Bartlett be requested to prepare a paper on the subject of carp, with instructions for cooking him.

An adjournment was here taken until 2:30 p. m., same day and place.

AFTERNOON SESSION, 2:30 O'CLOCK.

Meeting called to order by the president.

Mr. Bower: During the past year I have had considerable correspondence with Mr. A. H. Dinsmore, a member of this society, formerly of the state of Maine, but recently transferred to South Dakota. He is an employe of the United States Fish Commission, and I have rather encouraged him in the collection of a number of views, and he expected to be present at this meeting and give us an illustrated talk similar to those that we were entertained with last night, but at the last moment he found that he could not come. He prepared a large number of slides and has also sent in an introduction to his lecture, and has gone to a good deal of trouble and some little expense in the matter, and it seems to me we ought to recognize it in some way, especially as he has been encouraged by the official representative of the society and he is certainly entitled to a vote of thanks.

Since Mr. Dinsmore has been transferred to his new field in South Dakota, I have had a number of interesting letters from him. He writes me that he has run across a great many interesting things of a fishing nature out there, that the artificial propagation of fish has been remarkably successful, that in fact most of the fish they catch are salmon yanked from irrigation ditches, and that it is a common sight to see men and women fishing through the cracks in the sidewalk all through the city. (Great laughter and applause).

I will now with the permission of the society read a letter from Mr. Nat. H. Cohen, president of the Illinois Fish Commission, regarding the amended fish law which went into effect in Illinois July 1, 1901.

Mr. Cohen's letter read.

General Bryant, chairman of committee on resolutions, then presented the following report of committee on resolutions:

REPORT OF COMMITTEE ON RESOLUTIONS.

Resolved: That the thanks of the society are heartily extended to the Chicago & Northwestern Railway Company and

the Wisconsin Central Railway Company, for courtesies extended in enabling the members of the society to visit Bayfield:

To the proprietor and management of the Hotel Pfister for facilities furnished for holding our meetings and lectures:

To the several Milwaukee dailies for their kindly mention and full reports of our proceedings:

To Mr. J. W. Titcomb and Mr. C. H. Townsend for their very interesting and instructive lectures; and to Mr. A. H. Dinsmore for the excellent slides sent by him to illustrate fishing scenery, etc., on the lines of the Maine Central and B. & A. R. R. in Maine:

To Mr. Wm. J. Starr, for the delightful sail on the good yacht Rosamond:

That we extend our thanks to Mr. A. D. Mead, Mr. W. T. Thompson, N. H. Cohen, Livingston Stone, B. W. James, A. H. Dinsmore, C. C. Wood and C. G. Atkins, for the valuable and interesting papers submitted by them, and express our regret that the several writers could not be present to take part in the discussion.

That the thanks of the society are extended to Mr. Bower, secretary, for his able conduct of the duties of his office, and to all the various out-going officers of the society. We would be very glad, if we felt that the revenues would warrant it, to suggest compensation to Mr. Bower for the trouble and pains he has taken in the conduct of his office, but being somewhat frightened at the state of the exchequer we have not included such a recommendation in our resolutions. We would be very happy if it could be otherwise.

The committee report back the resolution relating to the Baird memorial and recommend the adoption of the following resolution, that the thanks of the society be extended to the committee having that matter in charge for their efforts in that behalf, and that the members of the society are urged individually to contribute the sum necessary to complete the work.

We would suggest that any other persons to whom we ought to extend a recognition of thanks, can have their names inserted by the secretary.

Report accepted and adopted, to be printed in the transactions.

The Secretary: I move that the introductory part of Mr. Dinsmore's lecture, which describes the wild-life scenes and portions of Maine where he collected this material, being a brief and very interesting description, be printed in the minutes of this society's proceedings.

Motion unanimously carried.

Mr. Clark: I move that the outgoing secretary turn over to the incoming secretary all letters and telegrams of regret, etc., and that the secretary acknowledge them, although they need not necessarily be published in the proceedings. These letters and telegrams show at least that these members take an interest in the society, and that should be recognized.

The President: That will be done as suggested.

Mr. Bower: There are three more papers which have been presented, viz.,

"Sturgeon Hatching in the Lake Champlain Basin," by Mr. Livingston Stone, of Cape Vincent, New York.

"The New Code of Fish Protective Laws of Pennsylvania," by Bushrod Washington James, of Philadelphia, Penn.

"Brook Trout Notes," by W. T. Thompson, of Nashua, N. H.

We probably have not time to read and discuss them, and I therefore move that they be printed in the transactions.

Motion unanimously carried and so ordered.

Moved that the secretary be authorized to edit and print 500 copies of the proceedings.

Motion unanimously carried.

The Secretary: I move that any member who furnishes a paper here be given five extra copies of the transactions free, if he wants them, by paying for the carriage.

Motion unanimously carried.

The President: I desire to remind you that at 4:30 you are to take a carriage ride around the city, and if there is no further business, a motion to adjourn will be in order.

The society then adjourned sine die.

Deceased Member since last meeting,

Collins W. Walton.



PART II.

PAPERS AND DISCUSSIONS



## THE POWER OF THE STATE TO REGULATE FISHERIES, AND THE TAKING OF FISH.

BY EDWIN E. BRYANT.

The purpose of this paper is to give some general principles as laid down by our Courts, as to the power of the State to control and regulate the taking of fish in all waters, save private and artificial ponds where the fish are rightfully confined from passing into waters not owned by the proprietor. No attempt is made to give the legislation of the various states, which is variant, changeful to fickleness, and oscillating from harshness and unreason to unreasonable laxity; and everywhere but indifferently enforced. The scope of this paper is confined rather to those general principles underlying all legislation on the subject of regulation and preservation of fish and game. It is rather a collation of the doctrines of the Courts than an expression of personal opinion. A few suggestions as to the proper framing of protective laws are added; and these, so far as they are the subject of criticism, the writer and not the Courts, must be answerable for.

I. *The ownership of Fish and Game.*—The fundamental principle on which legislation of this kind rests is that the ownership of fish and game in the wild state is in the State, in trust for all the citizens. English doctrine is that the ownership is in the King, as the representative of the sovereignty, in trust for his subjects. And it was centuries ago the settled policy of the common law that the hunting and killing of game or the catching of fish in public waters might be regulated under the police power of the government.

The property of the King passed to his grantees under the various grants made by royal charter, and vested as an incident of sovereignty in the states upon their being absolved from allegiance to the British Crown. *Martin v. Waddell*, 10 Pet. 367; *Russell v. Jersey Co.*, 56 U. S., 15 How. 426.

The power in the government to enact laws in regard to fish, to which this paper is limited, has been repeatedly affirmed by

the Courts. It was held by the Supreme Court of Massachusetts in 1809, that the legislature might regulate the taking of fish within the state and oblige all persons to conform to the regulations by inflicting penalties for the violation of them. *Burnham v. Webster*, 5 Mass. 266; *Nickerson v. Brackett*, 10 id. 212. This power may be exercised for the protection of the fish, to prevent extermination of the species, and for the maintaining of equality in respect to the right to fish, and the state may regulate fisheries by reasonable regulations. *Holyoke Water Power Co. v. Lyman*, 82 U. S. 500; *Fish Commissioners v. Holyoke Water Power Co.*, 104 Mass. 446.

The cases declaring or recognizing this right are very numerous:

- Barber v. Cummings*, 20 Johns. 90;
- Gentile v. State*, 29 Ind. 409;
- State v. Norton*, 45 Vt. 258;
- People v. Collison*, 85 Mich. 105;
- Magner v. People*, 97 Ill. 320.

II. *To What Waters the Right of Control Extends.*—The right of control and regulation of the fisheries extends:

1. To the inland rivers and streams, whether navigable or not, but it does not extend to private or artificial lakes or ponds, artificially stocked and having no connection by channel with other lakes or streams of a public character. The property of such fish is in the private owner.
2. To all lakes or ponds, except such as are subject to absolute private ownership. In the western states, the meandered lakes are not the subject of private ownership but the fee is in the state, of the soil below low water mark.
3. To private waters as well as to navigable streams; that is, to streams where the waters flow in non-navigable streams through the lands of more than one owner.
4. And each state owns the bed of the tide waters within the state, subject to the paramount right of navigation (*McCready v. Virginia*, 94 U. S. 391.), in trust for the enjoyment of the public right of fishery, which the state may control. *Manchester v. Massachusetts*, 139 U. S. 240. This right extends on the

shores of the ocean, a marine league from the shore. In these waters the state may regulate fisheries.

5. The ownership of the soil, under low water mark, in the lakes of the states, and the public right of fishing in them is disencumbered of any question of riparian rights. In Wisconsin, two decisions have recently been made which are of interest in this connection. In the case of the Nepee-Nauk Club v. Wilson, 96 Wis. 291, a small stream of water had expanded out into a pond from 35 to 65 rods in width and 3 miles long. It was known as Mud Lake, and there was little or no current during the greater portion of the year. The rushes and wild rice grew in the summer time luxurantly, and the surface was interspersed with mud and bog, leaving open some small spaces of clear water. In ordinary stages it was navigable only for canoes and small boats. It had been meandered as a lake in the original surveys. The Club acquired the riparian rights and sought to hold the exclusive right of fishing and duck shooting on the waters. The Court held against them, declaring that it was not a stream, but a "lake," and that their right to the soil terminated at low water mark. The public could fish and fowl there in open season, to the disgust of the members of the Club.

The other case, is that of the Mendota Club v. Anderson, 101 Wis. 479. The facts were that a dam had been put in at the outlet of Lake Mendota in 1850. This caused the waters to rise some feet and flowed lands not flowed or but partially flowed before the dam was built. Since the dam was built the lands claimed by the Club as its own private preserve were constantly flowed and navigable to small boats, sail boats, etc., and outside of the original meander line. In 1874, the title under which the Club claimed was obtained by a tax deed for the fractional lots to that portion of the shore. In as much, as if the dam had never been raised the riparian owners could have claimed much land that was covered by the flowage caused by the dam, the members thought their title to that part of the lake was exclusive, but the Court shattered their dreams of exclusive occupation of fine fishing and ducking grounds by holding the lake to be public waters, as far as it extended by the raise of the dam at least as against the title derived twenty-four years after the dam was built.

III. *The Legislature may prohibit persons from catching fish on their own land in the close season.*—The private right of fishery on one's own land, where the stream runs through one's land or therefrom onto the lands of others, is subordinate to the public welfare, and one may be forbidden by law to catch fish on his own land during the close season. *Hooker v. Cummings*, 20 Johns. (N. Y.) 90; *Com. v. Chapin*, 5 Pick. 199; *Vinton v. Welsh*, 9 Pick. 87. The right of the riparian proprietor is subject to such regulations as the legislature may make for the common benefit. *Com. v. Bender*, 7 Pa. Co. Ct. 624; *Peters v. State*, 96 Tenn. 682; *People v. Doxtater*, 75 Hunn. 472; *People v. Collison*, 85 Mich. 105; *People v. Hanaford*, 18 Me. 106; *People v. Bridges*, 142 Ill. 30; *Com. v. Look*, 108 Mass. 452.

IV. *The Legislature may prevent the Obstruction of the Free Passage of Fish.*—This is a lawful exercise of police power. *Com. v. Essex Co.*, 13 Gray 274; *Holyoke Water Power Co. v. Lyman*, 15 Wall. 500. And after a company had been granted a charter to build a dam, a subsequent statute requiring it to build a fishway is not unconstitutional. *id.*

Every owner of a dam or other obstruction in a stream holds it on condition that a sufficient passageway be allowed for fish to pass up and down the stream. *Stoughton v. Baker*, 4 Mass. 524; *Cottrill v. Myrick*, 12 Me. 229; *Parker v. People*, 11 Ill. 581; *State v. Slunke*, 21 Pac. 675; *State v. Roberts*, 59 N. H. 256.

V. *The Legislature may Prohibit the Sale of Fish and Game or the Shipment of the same from the State.*—The state legislature, in order to prevent the too rapid destruction of fish and game, have in some of the states, enacted laws to prohibit the shipment of fish or game from the state. These provisions have been the subject of important adjudication. In *Magner v. People*, 97 Ill., 320, it was held that, as the property of fish and game in the wild state, is in the state, and within the state control, the state legislature may prescribe the terms and conditions on which the ownership may be transferred upon capture, to the individual. And the state may as a condition provide that fish or game so captured shall not be shipped out of the state. The State of Connecticut, in 1888, passed a law that no person should kill woodcock, quail or ruffed grouse for the purpose of convey-

ing the same beyond the state, or should transport or have in possession with intent to procure such transportation, any of such birds killed within the state. This statute was challenged as unconstitutional. The Supreme Court of Connecticut sustained the law, and it went on writ of error to the Supreme Court of the United States. That court divided on the question, but the majority held with the state court, so that the principle may be considered settled that the state can forbid the killing of game or fish except for domestic use. The doctrine was stoutly combated in the dissenting opinion. Mr. Justice Field denied the soundness of the rule that the state was owner to the extent that it could qualify the ownership of one who had lawfully killed or taken the fish or game. He contended that after the capture the property of the captor was absolute, and that he could dispose of the property as he pleased, and that it being an article of commerce, the state could not restrict the sale of it to be sent out of the state. In this view Justice Harlan concurred. Brewer and Peckham did not sit in the case.

But here, it will be seen that judicial opinion is much divided. A state law of Kansas made it unlawful for any person to transport out of the state certain animals and birds embraced in the term "game." The defendant, an agent of the Adams Express Company, was prosecuted and fined under the act. He admitted the act, but contended that such acts constituted no offense as the act was unconstitutional and void. The Supreme Court of Kansas held the act void as interfering with interstate commerce. But here the court overlooked the crucial point,—that is, that the state can part with its ownership of game birds in the wild state on such terms and qualifications, as it deems wise, and can as a condition of the privilege forbid their shipment, after caption, out of the state.

The Supreme Court of Massachusetts has gone farther than other states, and farther than seems necessary. It holds as constitutional, a law forbidding the sale, during the close season, of fish artificially propagated in private ponds. *Com. v. Gilbert*, 100 Mass. 157.

The state laws forbidding the having in possession during the close season, or the serving as food at hotels and restaurants, are upheld. *State v. Beal*, 75 Me. 289.

Some difficulty has arisen here. The statutes are variant. Some include fish and game lawfully taken in the close season, and game or fish sent into the state from beyond its borders. Others, except these; and in some cases, where the statutes were silent on the point, the courts have held the state laws inapplicable to game lawfully taken and to that brought into the state. The burden of proof being on the state to prove that the game was of domestic origin, great difficulty in procuring conviction was found.

VI. *The Power of Wardens to seize and destroy Nets in illegal use.*—The legislature may by law declare all seines, nets, set-lines, traps, spring guns, etc., set for the unlawful killing of fish or game, public nuisances, and may authorize the officers to destroy them when found in such unlawful use. *Weller v. Snoover*, 42 N. J. Law, 341; *State v. Lewis*, 134 Ind. 133; *Lawton v. Steels*, 119 N. Y. 226-234. This kind of statute does not interfere with a constitutional right. It is analogous to those that declare it criminal to have in possession counterfeit money or dies or tools for making the same, or the laws which authorize the seizure of liquors kept for illegal sale. *Mugler v. Kansas*, 123 U. S. 623; *Kidd v. Pearson*, 128 U. S. 1.

The case of *Lawton v. Steels*, 119 N. Y. 126 is a leading and important one on this point. It was held by the court of Appeals of New York that the state might declare illegally set nets, when found in unlawful use, public nuisances, and that officers might destroy them when so found and seized. The case then was taken to the Supreme Court of the United States, the contention being that the state law deprived the owner of his property without due process of law. That tribunal affirmed the decision of the New York Court, and Mr. Justice Brown in his opinion discusses at some length the cases where there may be a summary destruction and those in which there should be an adjudication before there could be a destruction of the property. The instances where there should be a condemnation are those where the property is of very considerable value, such as a vessel, teams and supplies in lumbering horses, etc. There are several cases in the state courts, where a technical view has been taken and such laws declared unconstitutional. For example; In *Ieck v. Anderson*, 57 Cal. 251, the summary confiscation of the boats,

nets and tackle was held a depriving of property without due process of law. In *Jensen v. State*, 7 Ohio Com. Pleas 18, it was lately held that the statute of Ohio, giving the power to any person to take and summarily destroy nets, etc., illegally set and making it the duty of wardens, their deputies, sheriffs and constables to destroy such apparatus wherever found, whenever such officer should *think* it was illegally set in violation of law, was a depriving of property without due process of law.

It is manifest that such laws will always be debatable ground. The power is a harsh one, but that it can be exercised within certain limits seems clear.

Some statutes have gone further and authorized the seizure and destruction or confiscation of property that is in possession with intent to illegally use, or that has been illegally used, but is not in such use when seized. Such laws are of doubtful constitutionality and are unnecessary. *Bittenhaus v. Johnson*, 92 Wis. 586; 32 L. R. A. 380.

But the power of the state to declare as public nuisances, articles of property while in illegal use, is asserted in numerous cases.

*Cox v. Schultz*, 47 Barb. 65;

*Re Jacobs*, 99 N. Y. 98;

*McLaughlin v. State*, 45 Ind. 336;

*Miller v. New York*, 109 U. S. 385;

*Wood on Nuisances*, 1;

*Williams v. Blackwell*, 2 Hurlst, etc. 33;

*Smith v. Com.* 6 B. Monroe, 21;

*State v. Bailey*, 21 N. H. 343;

*Meyer v. State*, 42 N. J. L. 145;

And where one voluntarily places his property in a situation where the law says it may be summarily destroyed, he cannot recover either in value or kind. *Cooley's Const. Lim. Ch.* 16; *Com. v. Kelley*, 163 Mass. 169; *Campbell v. Evans*, 65 N. Y. 356; *Cook v. Evans*, 46 N. Y. 439.

VII. *The Power of Wardens and other Officials to enter upon Private Lands and there seize and destroy Fish Baskets, Traps, etc., set for illegal Fishing, even by the Proprietor of the Soil*, is well established.

*Weller v. Snoover*, 42 N. J. L. 341.

And the officers are not trespassers for so doing. id.

VIII. *The Right of the Riparian Owner to Fish on Waters covering his own Soil.*—We have one vexed question in connection with the stocking of streams, by state instrumentalities. At the Common Law as laid down in many American cases the riparian owner (whose right in fee to the soil extends to the thread of the stream, where the stream is his boundary, and to the whole bed of the stream when he owns on both sides), the right of fishery is in him exclusively, and no stranger can fish in the stream against his will without being a trespasser.

There are not wanting numerous authorities holding this view, even as respects navigable streams, in those states which hold that the riparian owner owns the soil under the water subject to the public right of navigation. It was held in Wisconsin that the owner of both banks of a stream owns the bed, and the owner of one bank owns to the center or thread of the stream, whether the stream is meandered or unmeandered.

Jones v. Pettibone, 2 Wis. 208, 319;

Mariner v. Schuette, 13 id. 692;

Walker v. Shepardson, 4 id. 486;

Arnold v. Elmore, 16 id. 509;

Norcross v. Griffiths, 65 id. 599;

Olsen v. Merrill, 42 id. 203;

Janesville v. Carpenter, 77 id. 288;

Barney v. Keokuk, 94 U. S. 324.

The right of fishing and fowling is in the owner of the soil under the water. Ne-pee-nauk Club v. Wilson, 96 Wis. 290.

This doctrine that the owner of the bank owns the soil under the navigable stream does not obtain in many of the states. In others including Wisconsin it has gotten unluckily a foot hold, and is an embarrassment to the stocking of fish for the public benefit.

In Wisconsin, the rule of riparian ownership of the soil carries with it the exclusive right of fishing in the waters over such soil has been overturned by the late case of Willow River Club v. Wade, 100 Wis. 86. The club leased the lands for a considerable distance on both banks of the Willow River, an unmeandered tributary of the Mississippi River, which was in times of high

water capable of floating logs and small row boats, though at other times row boats can not be taken up the stream without dragging or pushing them over shallow places. Wade, defendant, entered upon this stream from a public highway which it crossed, and thence went by boat up stream and caught fish by hook and line in a pond the plaintiff, the club, had created by erecting a dam on the stream, for the purpose of widening the stream and making a fish pond of it. The court after a very learned argument, held the stream a public navigable stream, and that the public had a right of fishery in it while passing up and down it, and keeping within the limits of the stream, and not going upon the owner's dry land to get to the stream. This happily settles one phase of the question, but others still perplex the subject of the stocking of the lesser streams.

IX. *The Legislature may prevent the pollution of streams, so as to destroy fish therein and may declare the pollution a public nuisance; and such pollution may be enjoined.*

People v. Truckee Lumber Co., 116 Cal. 397;

State v. Kroenert, 16 Wash. 644;

Blydenburgh v. Miles, 39 Conn. 484. Substantially the same rule has been applied in Wisconsin.

#### SUGGESTIONS AS TO PROTECTIVE LEGISLATION.

In view of the constitutional and other difficulties in framing adequate protective legislation, I venture to offer the following suggestions to those preparing legislation on the subject of protecting fish and game, confining the suggestions only to legal points:

1. The penalties should be imposed as *forfeitures* and not as *fin*es. The prosecution should be in the form of a civil action to recover a forfeiture and not for misdemeanor, in criminal form. The reason for this suggestion is that in most of the states, I think in all, the prosecution thus secures the right of appeal, when the justice or lower court, overawed by local sentiment, or sympathizing with the offenders, decides against the state. All wardens know the difficulties attending prosecution in the petty courts. There can be commitment to jail till forfeiture is paid, the same as in case of fines, and in the case of agents of trans-

portation companies no arrest need be made, or it may be made at the institution of the suit. The technicalities of criminal procedure can, to a large extent, be avoided by the mode of prosecution here suggested.

2. The statutes asserting the right of the state in wild game and fish to regulate caption, should be clear in declaring the terms on which they may be taken in open season, should specifically declare the conditions on which the state parts with its property. The right to ship out of the state should be qualified, or altogether restricted in clear terms.

3. A limited period of time after the termination of the open season should be fixed in which fish and game lawfully taken may be used or disposed of.

4. The plan of requiring license to hunt or fish to be taken out, by both residents and non-residents, is a good one. The small fee required should be used as a fund to defray expenses of protection.

5. Where fish or game are in possession in the close season, the burden of proof should be thrown on the possessor to show that they were caught in lawful time, or beyond the state and that they were lawfully shipped into the state from beyond its borders.

6. The laws should not apply to private hatcheries or waters isolated from others and owned and artificially stocked by private individuals. The private propagation of food fish should be encouraged rather than crippled. But care should be taken that this right be not made the cloak for illegal fishing.

7. The laws declaring nets, seines, etc., public nuisances and authorizing their summary destruction, should apply only to such as are actually taken while unlawfully set or in use, and, I think, it would be wiser, where they are of considerable value, to require a judicial condemnation before they are destroyed or confiscated. Where the illegally used articles are boats, guns, vessels, or long stretches of nets, it would be well to have them adjudged forfeited by a court of competent jurisdiction, under simple and speedy proceedings which give the offender his day in court, before they are adjudged to be destroyed or sold. These proceedings should afford right of trial by jury at some stage,

and better on appeal to the circuit court than in the petty courts where original jurisdiction may be vested.

8. Where the state expends large sums in stocking streams the right of the public to fish in them should, as far as possible, be secured. The right to share in the benefit of state stocking should not be monopolized by riparian owners. This subject is a delicate one to handle, especially where the old rule obtains that the riparian owner has the exclusive right of taking fish on his own soil. It will be held generally that he cannot be divested of this right by arbitrary legislation. From those who will not accord to the public this right, as to streams not wholly within their own soil, stocking should be withheld, as far as practicable. In Wisconsin, the law once provided that the applicants for stocking must dedicate their waters stocked by the state, to free fishing; but this law was found impracticable of execution and was modified. Here is need of careful legislation.

9. The state laws regulating the free passage of fish are usually utterly disregarded, or are dead letters because of their inadequacy. They need a thorough overhauling and more vigorous enforcement. The right of the public and of riparian owners to have passage ways for fish up and down the stream is a common law right and a valuable one. Yet, no right has been more systematically and flagrantly disregarded. This right extends to navigable as well as non-navigable streams. *Remley v. Meeks*, 51 L. R. A. 414.

The dam owners should be required to put in adequate fishways; and the game wardens charged with the duty of keeping them to the obedience of the law.

10. All statutes providing forfeiture, ought to prescribe and declare sufficient suitable forms for the guidance of wardens and officers in making complaints and magistrates in issuing warrants, rendered judgment and issuing other process. This avoids likelihood of mistakes that vitiate the proceedings.

#### DISCUSSION OF GENERAL BRYANT'S PAPER.

Mr. John W. Titcomb, St. Johnsbury, Vt.: It is a splendid paper. Every one who has to do with the administration of the laws as well as the work of propagation of fish, will appreciate the importance and value of having the different laws on the sub-

ject so clearly explained; and if it were not for the short time at our disposal, I should like to talk of some facts with reference to the stocking of streams with fish, and in regard to trespass laws. We think we have solved the problem in Vermont.

General Bryant: I am anxious to hear Brother Titcomb's explanation of how they have dealt with this question in Vermont.

Mr. Titcomb: With reference to the trespass law and the posting of waters, we claim, as your paper states, that all wild game is the property of the state; but take a stream that flows down the mountains for miles, through the valleys, and through several farms, each farmer claims that it is unlawful for any one to trespass on his property. In other words, if you go fishing on his land, or cross his land and fish along the banks of a stream flowing through his land, he can get actual damages for trespass, that is, one cent and costs, and of course he cannot ever keep fishermen off.

Now the state law provided a great many years ago that where a man posted the stream with a poster of a certain size as prescribed by the law, prohibiting fishing and hunting thereon, he could get \$10.00 in a civil suit in addition to the actual trespass damages. That law was held to be constitutional. The first embarrassment we met with in connection with that law was the fact that the fish from our state hatchery were going into these waters that were privately posted. We got the legislature to pass a law prohibiting the commissioners from stocking any stream which was privately posted. The result was that at the next session of the legislature the farmers who had streams came in there and said, we don't care a d—n for your hatchery; we don't get any fish; we want the fish in our streams and want to control them. The other faction said, the hatchery don't do us any good, the streams are all posted in our section; and the fight was so hot that the appropriation was held up and there was almost a deadlock on that question. I asked one of the members who was opposing our hatchery appropriation to withdraw a sweeping opposition measure and accept a compromise, which was done. Under the compromise act if a man wishes to have the privilege of obtaining \$10.00 in addition to actual damages for fishing on his privately posted waters, he must first stock those waters by

purchasing fish that are artificially reared. He cannot go to public waters to stock them, but must stock his stream at his own private expense from artificially reared fish, and keep it stocked. If we have a stream five miles long and one or two farmers post a mile or so of it, under the old law we could not stock the other part of it; but now the farmers buy their fish of a commercial hatchery and stock the portion they want to, the state stocks the rest of it, and that is open to the public; and the understanding is that if the state stocks any of these streams they are then open to the public. We have in connection with our application blanks question blanks so that we can find out whether the land owners agree to accept these fish from the state and will permit the public to have access to these streams after the fish from the state hatcheries are put in there; and the plan is operating very well. A good many who privately posted formerly have given it up and let the public on, and we stock their waters every year. A good many others are buying fish from the commercial hatcheries.

General Bryant: Then the legal effect of non-posting is an acquiescence in the public right to fish?

Mr. Titcomb: Yes, we do not claim that we can force the property open.

General Bryant: But you put the property owner in an attitude where he must waive his rights?

Mr. Titcomb: Yes; the legislature can say whether he shall have that \$10.00 additional damages.

Mr. Seymour Bower, Detroit, Mich.: I want to say a word in regard to one of the recommendations made by General Bryant, and that is in reference to the sale of brook trout by private breeders. It seems to me in a good many of the states we are altogether too severe in that respect. In my state a man cannot buy a brook trout from a private breeder and serve it to the public, in a hotel, without being liable to prosecution. Now in the state of Michigan I have no doubt that within five years, if private breeders could be allowed to put their trout upon the market, we would have twenty-five trout hatcheries at the least calculation, and would be getting fifty thousand dollars to one hundred thousand dollars of good Chicago and St. Louis money every year that we might just as well have as not; and it seems

to me that there should be some practical way to surround the sale of these fish with such provisions as will prevent the sale of wild trout. They do these things, I think, better in the state of Massachusetts than we do in the west. In that state, within a radius of fifty miles from Plymouth, are to be found perhaps twenty-five private trout hatcheries, from some of which five to ten tons of brook trout are marketed annually. They are allowed to sell their fish during the open season in which trout may be caught, and in addition they have a special law that allows them to sell in February and March, and as they have five months of open season, that gives them seven months in the year in which to market their fish. The denial of this privilege or right in Michigan (and I think it is the same in some other states) drives out what might become a considerable enterprise. I see no good reason why the production and sale of trout as a private or individual enterprise should not be encouraged rather than suppressed, no good reason why anyone should not be allowed to sell his own property, and I would like an expression of opinion from others on this subject.

Mr. Clark: It was my intention to say not a word in regard to this paper, but Mr. Bower has brought up this point and I wish to add my mite. That question has been before me ever since the law was passed in the state of Michigan. Time and time again, have people said to me that they would go into the business of raising trout for market, but they could not sell them. I do not believe—and I want to put myself right on record here as saying so—that any such law in the state of Michigan will stand. If I were a private trout breeder today, I would breed my trout, raise and sell them. I do not see how you can stop a man from selling his fish that he has raised in his own private waters any more than you can stop him from selling beef. But the law should be fixed so as to encourage this industry, and one result would be that we as public breeders of fish both national and state would have a better opportunity to buy eggs from different parts of the country, just as we do today from the breeders in the east. In Wisconsin, Michigan and all of these trout states, if that industry were encouraged by the law, in the first place we would have, as Mr. Bower says, a great many of these private trout breeders who would raise trout for market, and by having

the surplus trout we would have that many more eggs, because the eggs would simply go to waste if they did not save them, and thus eggs would be much cheaper.

James Nevin, Madison, Wis.: They are permitted to do that in Wisconsin at any time.

Mr. Titcomb: As to the constitutionality of that law there seems to be no question. Gilbert, of Massachusetts, caught trout out of his artificial rearing ponds, served them on his own table, complained against himself, carried the test case to the Supreme Court and was beaten. However the matter was finally compromised and I do not think that in Massachusetts or in Vermont (Mr. Root can tell you about Rhode Island) we experience any trouble from allowing artificially reared trout to be sold in certain months during the close season. In Vermont we have just passed a law looking to the encouragement of farmers putting in artificial ponds to hatch their own fish, to raise them and eat them any time in the year on their own premises.

The President: But they cannot sell them.

Mr. Titcomb: They are not supposed to sell them except in certain months, but the months that they are allowed to sell them are when there is a demand for them. I think if the matter is properly presented to the Michigan legislature there will be no trouble in getting a proper law there.

Mr. Root: We have experienced no difficulty at all in the matter in Rhode Island. We saw some years ago that such a law as exists in Michigan would oppress some of our artificial breeders, and I went before the legislature myself and had a simple law to this effect prepared and passed without any objection at all. The fish raiser goes to the secretary of state and registers himself, pays a small fee of a dollar and certifies that he will brand every package of fish that he sends out with the name of his concern; that has to be put upon the box; and that allows him to sell at any season of the year. There has been no complaint made of the law, and if anybody wants a package of fish he has merely to mark his package and that is *prima facie* proof that the vendor has a right to sell them, and these packages can be sold anywhere and at all seasons of the year.

Mr. C. H. Townsend, U. S. F. C., Washington, D. C.: It seems to me that the effects of legislation on the fisheries and on

fish culture are so far reaching that the entire time of this meeting might very profitably be taken up with the discussion of this subject. We know that the fisheries have a great many limitations on account of the laws, and there is a great lack of uniformity in the laws. A study of the subject and a report thereon that would lead to uniformity in fish laws would be of the greatest benefit to private fish culture. I have recently had some correspondence from Montana on this subject. There the conditions are different from any of those that have already been mentioned, and I have no doubt that if members from other states were to tell of the conditions prevailing with them, that they would be seen to be still different. In Montana commercial fishing from the streams is forbidden, but it is not forbidden to take fish from the public waters for the stocking of private ponds, and many people in Montana are industriously fishing to stock their private ponds and lakes. These immediately acquire a commercial value, and the sale of fish from such waters goes on, so that any one wanting to sell fish in Montana has only to get fish from the public waters and put them for awhile in their private ponds when they can be regarded as the result of fish culture.

A few years ago the statistical division of the Fish Commission made a canvass of the fisheries of the interior waters, where the commercial fisheries yielded over 50,000,000 pounds of fish. This year the same region was canvassed and we found that since the previous investigations the laws had been changed in many of the states. In Kansas, for instance, you cannot fish except with hook and line. The fish are no scarcer in these states but the fishermen do not get them. Commercial fishing being cut off in many states we found it useless to attempt a canvass of the commercial fisheries of several sections of the west, because of fish laws that prevent the utilizing of many kinds of fishes that could be taken if netting were permitted. Fish laws of the right and proper kind need not break up all fishery industries.

Mr. Geo. F. Peabody, Appleton, Wis.: The work of stocking the waters of Wisconsin by our State Fish Commission has been generously and intelligently done, and not only have the inland waters been stocked and those waters which furnish sport to the angler and the thousands who like to go fishing, but there have

been vast quantities of fry hatched and put in the out-lying waters for the benefit of the commercial fishermen.

Lake Winnebago and the Fox River (where I live) are the storm centers of illegal fishing, and the illegal fishermen and the pirates have been encouraged by the protection of the "A. Booth Fish Co." Wagon loads and wagon loads of illegally caught fish have within the last few months been taken en route from Lake Winnebago to Green Bay. They have been bought and shipped knowing that these game fish have been illegally netted in the inland waters of Wisconsin. It seems to me it is time the Fish Commission and Legislators take note of these facts.

Mr. Titcomb's remarks in which he said, "that they did not stock waters that were private in Vermont," is analogous to the idea that the State Fish Commission of Wisconsin should not propagate fish for the benefit of a corporation that assists piratical fishermen to break the law by buying illegally caught fish, knowing that such is the case. The transportation companies respect the law and refuse to ship fish from these waters, and the only way that we shall be able to correct the evil is to make it unprofitable for the illegal fishermen, first, by stringent laws, that make it possible to destroy the utensils, nets, boats, etc. Then to destroy the market, and the thing is done.

It would seem as if some one state might originate a clear rational law that could be adopted by other states that would be effective.

The President: I had this very point in mind when I suggested the subject of building up public sentiment. Before we can pass proper laws we have got to interest the public and create public sentiment in the interest of fish culture.

**MAN AS A CONTROLLING FACTOR IN AQUATIC LIFE.**

BY DR. J. C. PARKER.

The inexorable logic of human progress for the century, just past, would seem to indicate that "the Power that makes" in the Universe, if intelligent, had made a mistake in the arrangement of things: for instead of bringing man on to this stage of action as the last creative act, he should have been the very first and then left in absolute fee simple with the raw material of this earth at least—on his hands—to fashion as he might. For ever since his advent, he has been "eternally fixing things up" so that he might be more comfortable. He found himself in need of a "Shirt Waist" and other things and as the "Power that makes" had not furnished any, he had to hustle around and rob the wild beasts of their hides to keep his own warm. He wanted Milwaukee bricks and "Marble Halls" and the "Power" had only furnished dauby clay and rocky ledges. So he had to get up and hustle for a habitation. He found that his powers of locomotion were too slow, that in this respect the horse and the camel were his superiors and so he persuaded them to carry him wherever he wanted to go. But he wanted to go as fast as any thing on the face of the earth, and the fastest thing he knew anything about was the birds, so he wanted to fly. Well! he tried that but so far the bird is ahead, but he harnessed a tea kettle to a wagon and by keeping "eternally at it" he has a railroad and palace cars and has come as near flying as possible and keep his feet on the ground. He wanted to cross the river and he goes astride a log, then paddles across. Now he builds steam ships a quarter of a mile long, thus can go around the world in the time it would have taken to go from New Orleans to New York at the beginning of the century. He was afraid of the dark so lighted a pine knot, and that pine knot has grown to be an arc light and turns night into day.

Along every avenue of the inorganic he has been a builder. He is the only animal that has ever existed who has left anything besides his bones to mark his place in nature and if by any

convulsion he should be wiped out of existence, and in aeons of ages to come, some creature endowed as he is, should come upon the stage of action, he would still find evidences of his power as a builder.

But in the realm of the Organic! What of him there? A builder? No, only a destroyer! Down through the whole march of the ages, his record has been that of the most terrible beast on the face of the earth. His "Slogan" was ever: Kill! Kill! Kill! and every created thing from his own species to the worm under his foot has been the victim of his rapacity. Those beasts that he could not tame and make subservient to his need, he exterminated. Every beast of the field has learned to fear him. The birds of the air have learned to hasten and prolong their flight beyond his deadly presence. And in the waters that pulsated at his feet! What of him there? What is his record as a controlling factor in the life that swims on the surface or throngs in countless millions beneath? As we listen to the echoes coming up to us from the dawn of recorded history, and throbbing in the ears of the present, comes the eternal cry, Kill! Kill! Kill! From the huge Cetacean whose enormous build and terrible strength rivaled the Leviathan of the innovation of Job, down to the delicate anchovy whose brightness like a silver arrow gleames in the ocean's pelucid waters. In every tumbling brook, in every gliding river, in all the inland lakes shining like gems in their emerald settings; in and among all these he has been "eternally at it" killing and destroying, primarily to satisfy his hunger and his love of gain: and secondly to satisfy that innate love of killing that we euphemistically designate as "Sport." For no matter how much we weave around it the magic of poetry and charm of seductive language, yet all the way from St. Izaak down to that supreme juggler with apt words, Henry Van Dyke the "gentle art" is to kill as many of the fish that inhabit the waters as may satisfy this madness of destruction that riots in the blood of us all.

No one realizes better than myself, that there is another side to this question. There has never been a picture painted in words or on canvass of the beauties of companionship with nature, that has not been painted in my soul a hundred times. I know the sweet joy of the vagabond life of the camp: the uplift

that comes from breaking all the conventionalities of daily life: of getting close to the ground, and getting acquainted with its wonderful revelations; of the health renewing strength that comes in the wind that has swept across leagues of water and miles of forests filled with odors sweeter than any perfume: of the worshipful solemnity of the evening camp-fire, when you feel why fire-worship was the first religion: and you sit and listen to the many eerie sounds that come to your city tuned ears out of the solemn woods, wondering what they are and whence they come. And then the preparations for sleep that shall "knit up the raveled sleeve of care" for tomorrow. The splash and splutter of the brands of the camp-fire as you douse it" so that no stray zephyr shall send a vagrant spark into the tinder dry tent, and turn you out in a blaze of terror, and as you sink into the resilient bed of fragrant hemlock, what is the last conscious thought that engages our attention? Isn't it "We're going a-fishing tomorrow!" All the other delights are secondary to this. We take them all in, accept them, as though it was all we came for, and yet we know very well that we wouldn't be there if we weren't pretty sure that we could catch at least a few fish. Of course we are not "fish-hogs," a dozen trout or half as many big black bass would satisfy us, but we would certainly like to kill a few! for that is what we came for after all. No doubt there are those who could get all that has been described and bar the fishing, but I doubt if they ever find their way into societies like this. This brings us face to face with the fact that it is only when we find that these two factors, love of gain, and love of sport have been curtailed through our covetousness or stupidity, that we begin to search for remedies and to ask for the Why! and the How! of things. When commercial fishermen find that the margin of loss and gain, on a trial balance was perilously near the first item, they began to seek some method to rehabilitate former conditions, and when the disciples of Sir Izaak began to find that the streams where they fished when boys would no longer respond to the waving of the "magic wand," when they realized that the "flashing trout" could no longer "rise to the occasion" for they weren't there. And when they asked the old question, "What shall we do to be saved?" And the reply came back, "Sell all thou hast" if thou wouldn't go a fish-

ing. Then these too began to ask, Why! and How! To answer these two questioning factions, this and kindred societies have been formed, and through the enthusiasm and wisdom of those who from time to time have thus assembled, some of the problems have been solved, and year by year the How! has been pushed nearer to an answer. To reiterate the story of what has been done, would be to you but an idle tale. You all know what man has taken in that rehabilitation of the waters, from which he has so nearly exterminated their inhabitants. Many mistakes have been made in these efforts, but on the whole, there is I think a perceptible gain, especially in dealing with those waters, over which he can have nearly absolute control, like the inland streams. These he could stock with trout and in them could verify his work. It is the unverified portion of his efforts that is still in abeyance. From the first he has taken so many things for granted that it is no wonder there have been so many failures. If our work is to be recorded as scientific, not empirical, then there should be nothing taken for granted. Science is only an orderly arrangement of facts one fitting into the other like the link of a chain, and to study these from the genesis of life to the revelation of completeness is today the task that is set before the disciples of scientific pisciculture. Our work in the past to which we brought the best that was in us, has been largely empirical, and our reasoning of the *a priori* order.

When the fact was demonstrated that the ova of certain kinds of fish could be artificially fecundated and hatched, it was then assumed, that if the fry were planted in the waters almost anywhere then the problem of the future supply of the fish was practically settled. So we proceeded to hatch them out by the hundred of millions and dump them into the waters, usually those from which the parent fish had been taken, it being assumed that a large proportion ought to survive to maturity. But somehow there seems to be a hitch either in Nature's plans or our own for after a score of years' trial and a large expenditure of money, we have no assurance that there has been any marked success. In fact we are not *sure* that any one of these hundred of millions has reached maturity. We are not even sure that there has been any particular gain in any one locality. True from time to time our hearts have been gladdened with the reports that the

fish have become suddenly much more abundant, and we have no other satisfying reason, why this state of affairs should exist, and we have concluded that it was through our efforts. But have we been equally fair in our statements of our failures? When a few years ago the whitefish began to be caught in commercial quantities in Lake Erie, after a lapse of many years of depletion, we ascribed this sudden development to the efforts of Ohio, Canada and Michigan, in planting them in the lake. A similar phenomenon occurred in Lake St. Clair in the earlier efforts of the Michigan Fish Commissioners, and we were greatly elated thereat, but of those planted along the eastern shore of Lake Michigan I am forced to say there was never any perceptible showing. Depletion went on with each decade, until today we stand face to face with the fact of an almost fishless sea.

Now pessimism is one of the easiest of virtues, and to prophesy after the event is consummated, is a good deal like "betting on a sure thing." But it really does seem as though man as a producing factor in organic life has not been a "howling success." It seems to me that the greatest need is that of verification.

In the case of our minor inland waters, notably those in which the brook trout would live, verification of our efforts was easy: and it was this that gave the supreme impulse to our efforts in pisciculture. If all the other work could have been verified as this has been, all fish culture would today be a scientific and practical success. Perhaps there is no fish that swims in which we are more interested than in the Queen of the Lakes, the White Fish. Fifty years ago, it was one of the most common, as it is the most delicious of fishes. We have seen it slowly decimated until today it has passed from a common article of food to a semi luxury. And if the same rate of depletion continues for another half century, it will be one of the most costly of luxuries. We all know the comparative ease with which the ova of this fish can be collected, and the large percentage that can be hatched. And if we could in any way verify the progress, after planting, as we can the brook trout, "the two blade of grass man" would not be in the "benefactor business" with us for a day longer.

To point out blunders and grumble at existing conditions,

without suggesting a remedy, is hardly the province of the reasonable man, and while I have only a tentative plan, certainly not a scientific one. Still it is comprehensive enough to possibly determine the value of planting the whitefish in a large body of water. Lake Ontario was once bountifully supplied with this fish. Today—if my information is correct—it has but very few. Now if all who have an interest in the successful propagation of this fish could pool their interest, and first make an exhaustive examination of this lake to ascertain the exact conditions now existing, as to its aquatic life. Then all the states interested together with Canada and the general government hatch as many millions of whitefish as possible, for say three years, planting them all in Lake Ontario. Then if possible prohibit all commercial fishing for five years it seems to me that it would settle the question for this lake at least, and indirectly for all the others, and possibly demonstrate whether man could be a controlling factor in the larger schemes of constructive aquatic life.

There is another phase of aquatic life to which but little attention, so far as I am aware—has been paid, and that is the plant life of all the waters, of the sea, no less than that of our lakes and streams. As on the land, all animal life is dependent on the vegetation, so in the waters, there could be no organized aquatic life without the primary existence of aquatic plants. In this field, man has indeed been a controlling factor, and may find, possibly, that in the future his best constructive work may be in the study of the growth and conservation of the plant life of the waters. Many times have I known the aquatic life in our inland lakes nearly obliterated by the deepening of the outlet of a lake, in order to reclaim some bordering marsh. If when you are on a lake or stream, you will pull up any of the water plants, during their active summer's growth, you will find them covered with larval or crustacean life. On this small fish feed, and ten large ones on the smaller. And thus the balance of life is complete. Interrupt this in any manner and you have destroyed the delicate poise of the balance. By lowering the water line, the plants will wither and dry up, and with them the life that depended upon them for their sustenance and growth. Then the swarms of minnows deprived of their friendly shelter and food, either starve or become an easy prey to their predacious neigh-

bors, who after having eaten the "fatted calf" cannot find even the "husks to fill up on" and so succumb to the inevitable. I have known lakes in which there was fine bass fishing to become completely depopulated in three years by a foot or two's lowering of the original water line.

To my mind, it is not at all impossible that some disturbing or destructive influence of the flora of our great lakes has more to do with the depletion of its whitefish than the greed of fishermen. I remember very distinctly the surprise that I experienced when I first discovered the food of the whitefish. It was soon after my appointment on the board of the state fish commissioners. I could find no one among authors or practical fishermen who could give me any information as to what they ate. So I made a trip to Grand Haven, at that time having a large interest in the catching of fish. One of the fishermen turned over to me possibly a barrel of intestines, and I started out with a sharp knife, a stout stomach and lots of ignorance to find out what whitefish lived on. I worked diligently for an hour cutting open stomach after stomach but without any result in finding what I was looking for. In nearly every one I found more or less sand mixed with the mucus of the stomach. I finally came to the conclusion that as the fish had been caught in gill nets their detention there had emptied the stomach of all food. Just as I was about to give up for that time I thought I would see how the inside of the stomach looked under a magnifying glass I had in my jacket. Incidentally I looked at some of the sand, when to my intense amazement I discovered that what I had regarded as sand was the shells of a minute bivalve but little larger than a grain of sand and so translucent as to shine as a grain of sand. Of course this was a new world and I commenced all over again, and left with a very thorough knowledge of what those white fish had been feeding on, for there were the shells in all stages of digestion from those recently taken in, to the shell from which the animal had been removed by the digestive process. Still what I found seemed so insignificant to the size of the fish that I thought there might be some mistake so I concluded to remain over night and verify my observation by the next day's catch. I did so with the same results. Then I thought it might be a local matter, and so a few months after I

found my way to Mackinac where I made examinations finding only the same evidence of food in fish caught there. Later in the stomach of a ten pound white fish caught on the south shore of the peninsular, north of the Beaver Islands, I found some shells of the genus *Melania* and *Paludina*, shells half an inch in length and one-fourth inch in diameter, but shallow water shells, the habitat of which is well known, but I never was able to find the smaller shells only in the stomachs of the whitefish. I am not aware that they have ever been found in their native habitat, or what the vegetation is on which they feed. Of course it may be begging the question to assume that they are vegetarians but the natural sequence of life, so far as we can demonstrate it would lead us to infer that such was the case and if it is, the fate of this fish is to be determined by the growth and continuation of this plant wherever and whatever it is.

I think that man as a builder in organic life especially in aquatic life will work along these lines. What is true of our "unsalted seas" is true of the salt ones. And when in the future the problem of life in the ocean shall be studied from this point of view, some of the puzzling phenomena of ocean life may be solved. The immense schools of migratory fish like the Mackerel, the shad and alewife. On what do they feed? As they are doubtlessly carnivorous and as we must "hark back" to the vegetable world as the genesis from which all organic life proceeds. So in the future the province of man as a factor in aquatic life may possibly be in sowing the fields of the ocean as he today sows the fields of the land.

#### DISCUSSION OF DR. PARKER'S PAPER.

Mr. Titcomb: I was very much interested in the doctor's remarks and I have often thought that it was unfortunate that we could not show results and prove that they were the results of artificial propagation. He has stated that it is possible with the trout and has been demonstrated. The subject of the growth of fishes under natural conditions is interesting. The fish culturist is so frequently asked for information as to the growth of fishes after being planted that I give the following statistics:

In the spring of 1897 lake trout fry were planted in Big Averill Pond in the town of Averill, Vermont. Each successive

spring lake trout fry have been planted in these waters. When the first plant was made the lake contained a few brook trout, a few golden trout (*aureolus*) and many shiners, dace and suckers, but no lake trout. In June, 1901, I caught with rod and surface troll four lake trout weighing three and one-half pounds, two and three quarters pounds and one and a half pounds respectively, and one fish ten inches long which was returned to the lake alive and not weighed. I was informed by the landlord of a sportsman's resort nearby that the lake trout caught by other fishermen did not vary an ounce from the weights above given. In other words, that the fish representing the various ages from one year to four were quite uniform in weight. The standard weight for a four year old lake trout is therefore three and a half pounds, for the three year old two and three quarter pounds, two year old one and a half pounds, one year old about three-quarters of a pound. Of course the growth may be greater or less in other waters, but the above is an accurate basis for data. I may properly add that my landlord informant considered that his property had doubled in value in the short space of time that this lake had demonstrated results from stocking with artificially hatched fish.

In the fall of 1897, landlocked salmon, fingerlings, were first introduced in Caspian Lake, Greensboro, Vermont, and plants have been made annually since that time. Previous to 1897 the lake was well stocked with smelts. In May, 1901, one landlocked salmon was taken with rod and line, weighing eight and a half pounds, one weighing seven pounds fourteen ounces, and many others weighing from two to five pounds. The lake contained no salmon previous to 1897. The lake is about two and a half miles long by one mile wide at the widest place. It contains speckled trout, ranging from a small fish to five pounds in weight, and lake trout averaging about five pounds in weight, but frequently caught weighing from nine to fourteen pounds. The lake trout were first introduced in 1891.

It is safe to say that a daily average of 200 pounds of trout and salmon were caught from this lake on week days through the month of May, 1901, the results of artificial propagation. In many places we cannot prove that the fish caught were artificially hatched, but the above examples furnish very definite data.

Mr. Clark: I was very much interested in the doctor's paper, but still that paper as it will go to the press affords rather a discouraging outlook for artificial propagation, especially of whitefish. One would infer from the doctor's paper that no results really have been shown with the whitefish. If in order, I want to make a little argument on that point.

It is true that the different states bordering on the Great Lakes, as well as the United States Fish Commission, have planted billions of whitefish in various waters. One-half of those whitefish, I venture to say, have gone into Lake Erie waters. It is well known that the whitefish are on the increase in Lake Erie. The doctor referred to Lake Ontario as being depleted. Lake Ontario until very recent years has had practically no whitefish planted in it—now and then a car load, but very few. Of course in the past four or five years probably 20,000,000 to 30,000,000 or so have been deposited each year. Lake Michigan, Lake Huron and Lake Superior will never show an increase, but will on the contrary show a decrease, until hundreds of millions of whitefish are planted in those waters. We must admit of course that the whitefish grow, because that has been demonstrated. We have lakes in the interior of Michigan today where there never was a whitefish until planted, and we know they are there now. I have caught them thicker with a gill net, myself, than in any gill net I ever saw lifted on the Great Lakes. We know positively that the whitefish that we hatch grow. If we plant them in the lakes and find the whitefish increase, the increase must be due to artificial propagation and planting. I contend that Lake Erie and Detroit River are beyond the time of going back and that they are on the increase as the records will show today, and I never expect to see Lake Erie begin to drop down. Of course it has its years when it will be a little better than others. For instance, the records for last year when completed will not compare very favorably with those of the preceding year, 1899, which showed an increase of 100 per cent. over 1898. Last year there were not so many whitefish caught but that was on account of the weather. On Detroit River last year with three seining grounds the catch was 20,000, and a year ago last fall, 32,000.

The President: And all of the same size practically?

Mr. Clark: We did not have a thousand whitefish by the 15th of November, and all of the balance were caught within about three weeks after that. The year before, we had ten thousand up to the 15th, showing conclusively that it was the weather that kept them from coming up. Mr. Downing had about the same experience in the upper end of Lake Erie.

I do not want to let the statement go unchallenged that the whitefish in the Great Lakes are not on the increase, and I mean Lake Erie more particularly, because so many whitefish have been planted there. Now if we will plant in Lake Michigan, Lake Huron, Lake Superior and Lake Ontario, as extensively as we have in Lake Erie, we certainly shall see the whitefish increase greatly.

The food question today has a great deal to do with the subject. I never expect to see the Great Lakes, even with billions upon billions of fish planted each year, back where they were, because, since civilization has stepped in, we have so much deleterious matter running into them destroying not only the spawning beds but the feeding grounds. The problem may become a serious one, unless science can show us some way of increasing the food of the whitefish; but the fact that we can increase the whitefish is undeniable, for we are doing it right along.

Prof. M. C. Marsh, Washington, D. C.: Dr. Parker refers to the difficulty that there would be in getting an agreement over on Lake Ontario between the states and Canada in regard to this matter. Inasmuch as it is often difficult to obtain legislation from a single state, we may well imagine that it might be very difficult to obtain an agreement between several states and Canada. A very important planting investigation almost exactly in the line that Dr. Parker has suggested has been going on in regard to aquatic conditions in Lake Erie, and a similar investigation has been made also in relation to salt water fish.

Mr. Townsend: I do not know whether the members of the Fisheries Society are familiar with the more or less regular statistical canvasses that are made of the fisheries of the different parts of the country. But it takes a good while with the small statistical force of the United States Fish Commission to get over the ground. They canvass the Southern Atlantic and Gulf states in one season, the Middle Atlantic and New England in

another, the Great Lakes and Mississippi another, and then the Pacific coast; it takes three or four years to get over the ground.

The last canvass of the fisheries of Lake Erie showed that there were caught 58,000,000 pounds of fish in 1899, 42,000,000 in 1893, 64,000,000 in 1890, 51,000,000 in 1885, and 29,000,000 in 1880. There has been considerable planting of fish and there has been a great development of the commercial fisheries. The figures are correct as far as they go. We are on pretty intimate terms with the fishing firms and every one of them throws open books and records and our figures are copied from these books. The catch is generally larger than the reports show, because we do not see all the fishermen. We do get hold of the fishery firms however. You will see by comparing these different years with the recent catch of 58,000,000 pounds in Lake Erie that that catch is nearly as big as that of the best year, 64,000,000 pounds, and it is away over what it was in 1893.

Let us take the Great Lakes as a whole; in 1889 these lakes yielded 113,000,000 pounds of fish worth \$2,500,000, and there were nearly 10,000 fishermen. This yield compares favorably with that of other years.

Here are some fishery facts that I think you will appreciate: There are 19,000 fishermen on the Pacific coast, taking 219,000,000 pounds of fish a year worth \$6,000,000. The catch of shad and striped bass in the Pacific coast states by this canvass,—and these figures were collected by trained statistical agents,—was nearly 2,500,000 pounds, but there never was a shad or a striped bass on the Pacific coast until they were carried overland and planted there.

Mr. Clark: I carried the first 600,000 that were taken there myself.

Mr. Townsend: I think that the study of statistics will show the direct and positive benefits of fish culture in all parts of the country.

The President: Nothing shows it better than the culture of brook trout.

Dr. Parker: Verification is just what I contend for. They verify those things by taking the shad and striped bass over there. But what I contend is that they do not get the results from planting whitefish in the Great Lakes in proportion to

what has been done with other fish. I say that in all probability we can account for the condition of affairs in Lake Erie by the increased number of fishermen going there for the reason that it is better fishing.

Mr. Clark: But it is better fishing there because there are more fish.

Dr. Parker: We do not know whether that is the result of planting or of natural causes.

Mr. Clark: How will we ever know? Take your brook trout streams in Michigan today that were planted before they were depleted, how do you know that your brook trout lived there?

Dr. Parker: Because you have put the brook trout where there was none and they have grown.

Mr. Clark: No, no, but take the natural streams where there are plenty of trout.

Dr. Parker: There are plenty there today.

Mr. Clark: But according to your argument I might just as reasonably say that your artificial trout that have been planted in those streams do not live.

Dr. Parker: You do not know whether they live or not.

Mr. Clark: No.

Dr. Parker: I am taking this thing up from a scientific point of view, considering the actual facts of the case—that is all—I heartily believe in the commission, and my suggestion as to the planting in Lake Ontario there in that way is simply to prove if you can the value of planting in large numbers, stocking a lake like Ontario. It is only a suggestion.

Mr. Clark: That is just the point I am arguing that the vast quantities of whitefish that have been planted in Detroit River and Lake Erie must make the increase, for we certainly have an increase there.

Dr. Parker: But you assume that this increase is due to the fish you plant there.

Mr. Clark: I dislike to take up the time of the society but this is a very important question and it must be discussed here. The doctor says, "Take Lake Ontario" (which of course is a good example; it is all right), but how will we prove anything better in Lake Ontario than we have already proven in Lake Erie? The only difference between the two lakes is this, that

Lake Ontario is a little more depleted; but the whitefish are not all out of Lake Ontario. Whitefish have been caught in Lake Ontario every single year.

Mr. Townsend: Yes, but the laws of New York so restrict commercial fishing in Lake Ontario that you cannot tell anything about it.

Mr. Clark: If we should plant billions of fish in Lake Ontario could we prove any more clearly than we already have in Lake Erie, that our fish grow there?

Dr. Parker: It seems to me you could, simply from the fact that an exhaustive examination of Lake Ontario should be made first on a really scientific basis, and then stock it in that way, and then if you could prohibit fishing for five years and then found that the fish had increased there, you would certainly have verified in that lake and presumably for all other lakes, the fact of the growth of the fish planted. That is all that I contend for—not that I am inimical to planting fish—not by any means.

The President: The catch on the Detroit River year before last was bigger than for years before and was all of such uniform size that it is almost positive evidence that they were planted fish.

**THE INDEX.**

BY JOHN E. GUNCKEL.

The American Fisheries Society is likened unto a lake nestled at the foot hills of the Rockies which contain all the songs the mountain brooks and streams have sung. Drop by drop from the snow-clad, unexplored peaks, the water forms overflowing basins, hesitating pools, miniature cascades, and cataracts of unsurpassed grandeur and magnificence; lost for a time in the recesses of heavy forests and then peacefully flowing through overland meadows of wondrous shades and beauty.

It took thirty-one years to gather into this American Fisheries lake the knowledge gained by systematic observation, experiment and reasoning of its members.

The records of the past century reveal that this society, within its life, has made more progress in the details of scientific researches than during all the past centuries. As evidence of this fact read the official reports of the transactions of our society. The progress in the art and sciences made by men whose lives were devoted to the beneficiary work of mankind should receive more than a passing notice and recognition of their discoveries and labors.

It is therefore fitting that we should frequently stop in our active daily work and pay tribute and respect to our absent fellow companions who worked so diligently and earnestly with us for so many years and are now sleeping away the centuries. Men who devoted their lives to the cause of fish culture, the fisheries and marine biology, and "The only reward they asked—a grateful remembrance of their work."

Dr. Theodatus Garlick, Prof. Spencer F. Baird, Prof. G. Brown Goode, Judge Emory D. Potter, Col. Marshall McDonald, Fred Mather, Herschel Whitaker, Henry C. Ford and many others whose names and valuable works you will recall. Around these men circle memories that time cannot efface. These men were leaders in biology and general scientific researches. To them and their associates the American people owe much; more than a memorial tribute of words. They discovered and harvest-

ed fields that many of us today are but gleaners. In the life of this society the road was discovered that is leading rapidly to the solution of great problems in nature's marvelous works. Fish can now be artificially hatched with more success than nature gives to the fish in their natural elements. The hatching facilities of every state in the union should be so enlarged and improved that millions of young fish can be planted every year of our most important food fishes. This is helping mankind. Today the life of each inhabitant of God's creative waters is known to the fish culturist and biologist from the fry and fingerling to the self-supporting fish, and all diseases known to fish from the trout down to the palatable cooking of our much abused German carp. In the memory of all of us, who have watched the interests of this society, we recall the papers and discussions giving the results of hard labor and untiring study in detail of the successful hatching and caring for almost every species of our food fishes.

So deeply interested were the workers in details that it made but little difference what subject the member was pleased to introduce the discussion invariably ended in fry and fingerlings arguments.\* It seems that the beginning of a new century found this fry and fingerling subject amicably settled between the two great contestants, namely—the Michigan Fish Commissioners agreeing with the New York Fish Commission that the future welfare and the progress of the fish, for the benefit of mankind, “depends upon the health of the fry, the condition and surroundings of the fingerlings.”

So thorough and complete has been the successful workings of the members of this society that the world is not surprised to learn that they are daily cultivating fields in new and unexplored territory. We are not surprised to learn that the members of the Wisconsin Fish Commission are not only contemplating the hatching of whales at their Bayfield hatchery but they are on record as promising “to hatch a brewery for each member in attendance at this meeting,” and we are informed they stand ready to fulfill their promise.

What of the future?

In the index of today we find the members of this society are branching out in other pastures. Some are endowed with talents

other than those of solving nature's mysteries. General E. E. Bryant, one of Wisconsin's favorite sons, while under the influence of a Narragansett clam bake, and the ozone of Wood's Hole, surprised the members that he was a natural born orator; deep, inspiring, pathetic, amusing, and that he lost himself in such an overflow of language that the members of the Michigan Fish Commission are still searching the dictionary for fry and fingerling meanings.

Again, the medium through which the public is benefited from the results of the labors of individual members is the record of transactions. It is an honor to this society, a great credit to Secretary Seymour Bower, for the complete and general arrangement of the report for 1900. Would it not be well for this society to go still farther in their annual reports by following New York's most elegant official report of the State Fish Commission? A volume more complete than our present form would be an everlasting honor to our society. In glancing at the many papers and discussions of men like F. N. Clark, C. E. Brewster, H. W. Davis, George F. Peabody, A. N. Cheney, Prof. A. D. Mead, Hon. Eugene G. Blackford, W. DeC. Ravenel, Hon. George M. Bowers, J. W. Titcomb and many others we are not surprised to learn that they are uniform in one belief that great problems of the future increase of our food fishes center in the success of what is now in progress by active members of today who are to read papers and discuss this new movement. No man is better able to tell us what is required of our legislators to guarantee to the people, "Practical Protection and Perpetuation of our Wild Life," than our esteemed Grant M. Morse, Michigan's State Game Warden. He has carefully studied the past and concludes that there is but one way to make this a success. He argues that men and fish are now one, that fish planted in the lakes and streams hatched by members of this society feel as if they were under obligations to their friends—the fish culturists. Therefore, he will suggest that fish should be requested not to feed upon their kind, not to enter a net or trap, or other evil devices of man, and do away with "Uniform General Laws." This idea is sanctioned by one of our oldest and most revered members, Dr. J. C. Parker, for he is satisfied that, "Man is a controlling factor in aquatic life." We have had hints of this

coming event from the studied pen of F. N. Clark, who, back in the nineties declared that, "Fry and Fingerlings one day would form a trust which would unite the food fishes of our waters." C. E. Brewster also told us that, "There will come a time, some day, when fish will understand each other." Seymour Bower, who knows every fish by name is recorded as saying that, "Fish in our Michigan waters have been casting Goo Goo eyes at each other to beat the band." Dr. James A. Henshall who is studying the habits and dispositions of our mountain stream fishes said, in the long ago, "In the study of the black bass we are convinced they are leaders and at no distant day will they unite in a powerful combination for self protection." Georgia's famous fish culturists through J. Bayard Lamkin in his paper on, "Feeding of Black Bass Fry" and J. J. Stranahan, late of Ohio, have come to the conclusion that to, "Prevent Cannibalism in rearing black bass," is to teach them in their fingerling years to eat Georgia watermelons and other carp nourishing delicacies. There is a unity in this problem even after death, for S. P. Bartlett, Illinois' carp champion, in his "More About Carp" will tell us that there has been no fish ever discovered in ancient or present times which can be served in more courses and under more different names than our Illinois carp.

These are pleasing problems and incidents arising from past associations with men of this society, living under their influences, and we desire to add to the ties that bind, our word of appreciation, to those who daily toil in the biological fields that, we humble disciples of Isaac Walton love to cast our lines in pleasant places.

Sitting on the banks of this American Fisheries lake are men of my nature and kind, endowed with truthful proclivities.

Men who love to fish in its peaceful waters and get inspiration from the purple shadowing landscape. Men who love to angle, and by their nearness to nature and nature's God could not tell a lie if they saw it.

We are in touch with our scientific workers, although we may not understand all the new ideas advanced in the aquatic life, but we do agree—

"That in every kind of weather  
Under cloud or in the sun  
Trout and minnow play together  
When the American Fisheries meet."

## THE BROOK TROUT DISEASE.

BY PROF. M. C. MARSH.

The affection which I have designated "*the brook trout disease*" is one which has caused the United States Fish Commission considerable trouble of recent years. The first occurrence that was particularly studied was at the Northville, Mich., hatchery in the fall of 1898 and following winter. It has also occurred at Manchester, Ia., at the commission's station. These places have had, I think, regular recurrences of the disease each season since the initial attack. It has recently for the first time taken hold of the Loch Levens and it is therefore probably not essentially *the brook trout disease*, though it seemed such at first, for no other species was affected though identically exposed, and it was the only serious obstacle to brook trout culture.

Members of this society are doubtless familiar with the account by Prof. Calkins of a very interesting epidemic among brook trout, published in the report for 1898 of the Fisheries, Game and Forest Commission of New York. This took place on Long Island, and is, like the one under consideration, an infection, i. e. it is caused by living parasitic micro-organisms. They resemble each other in severity and in external lesions, but I do not however believe the parasites are identical in the two cases.

In the earlier literature of fish culture this disease does not appear, none of those described so specifically by Livingston Stone as affecting fry being identical with it. Mather however describes one at Cold Spring Harbor, N. Y., which resembled it and might have been the same. He sent circular letters to various fish culturists, inquiring for similar epidemics and but one reply described a similar and perhaps identical experience. This was at Caledonia, N. Y., in 1883 or 1884.

In this paper I intend to describe the disease only briefly, but to enter at some length into the question of its prevention and to present for your consideration and criticism the reasons which seem to me to justify the plan for putting prevention into practice.

In the experience of the commission the disease affects chiefly yearlings, but also fry. The first symptom is a loss of activity in the trout. The individual becomes weak and is not ambitious enough to stem the current of the pond, and perhaps allows it to drift him against the screen at the lower end. He does not attempt to avoid the net and is easily taken. He still remains right side up, breathing quietly. He is apt to make spasmodic efforts to swim, but does not go far and turns partly over in the attempt. This is the beginning of a loss of equilibrium, which becomes complete, and the trout lies on his back or side at the surface or bottom, gasping. After occasional proxysms or frantic dashings in apparent great distress, death soon occurs.

Examined post mortem these trout have not fallen off much if any in condition. More than half of them have no external marks of disease and these look like fine healthy fish. But some have very plain external lesions, the essential feature of which is an extravasation of blood into the tissues. It is seen chiefly in the muscles, and appears in its simplest manifestation as a mere red streak or patch, or bloody blotch, while its ultimate or extreme condition is an ulcer. All intergradations between these two stages may be seen. That is to say the blotch of blood commences to liquefy the muscle surrounding it and the place becomes soft to the touch. It swells slightly or considerably, and may make an elevation or puffy swelling which looks like a pustule or boil. This is usually red or purple in color and rather soft or yielding, but sometimes slightly tense when the skin remains firm, showing the existence of some pressure from within. These are found on comparatively few of the dead fish as they usually die before reaching this stage. The skin finally sloughs and makes an ulcer. The location of these lesions may be anywhere on the trout, but favorite places are the bases of the fins, most often the pectoral, and the sides of the head. There are but few internal evidences of disease visible to the naked eye.

These boil-like elevations are not boils nor abscesses proper, for they do not contain pus and the infection is not a suppuration. Their contents are a bloody liquid which consists of the serum of the blood, some red corpuscles and a good many white ones, degenerated muscle fibres, and countless numbers of bac-

teria. There is no excess of white blood cells as would be the case if pus were present.

The disease is extremely fatal. Usually if the fish remain in the pond in which they acquired the disease, the death rate continues, the number dying each day becoming fewer as the school grows smaller, until the last one has turned his belly upward.

Now, what is the nature or cause of this mortality? Is it merely a question of bad hygiene, that is, not a specific disease, but merely a condition due to the surroundings, or food, or unsuitable circumstances? The fish cultural conditions are all that care and the application of the most approved methods can make them. The disease is not a mere matter of hygiene but is an infection, i. e., parasitic. Living organisms, foreign to the trout, have obtained a foothold, inhabit and grow within the body of the trout and at its expense. The blood and local lesions of the affected trout contain bacteria, in some cases in great numbers, and the infectious agent which causes all the trouble is believed to be bacterial. Proof is still wanting, but experiments are under way which I hope may furnish this.

But it may be considered established that the disease is an infection, which for our present practical purposes is the important point. It is caused then by a living parasite, an extremely small one,—a micro-parasite, which carries on operations chiefly on the inside of the fish instead of the outside. It is not easy to attack successfully the parasite in this position without doing violence to the fish itself, and I will put aside this part of the subject for the present. Prevention is worth more than cure.

Prevention suggests the question of the original source of the infection. Where did it come from, how did it get into the trout, and how may it be kept out? The original source is perfectly obscure at present, and may always remain so. The presence of the infection is more apparent than its origin and destiny. Yet there are some general considerations which have a bearing. There was a time, at Northville for instance, when these epidemics did not occur. It is unlikely therefore that the specific germs were normally and constantly very abundant. They were either constantly present in the environs of the ponds in small numbers, or at some time they became temporarily numerous. In the former case their constancy, in the latter their numbers, en-

abled them to gain the foothold in the brood of fish. Of course the virulence of the organisms is another factor which enters in. The foothold is the important thing. Now, where were these germs before they got inside the trout. The air contains many bacteria. But it is the less likely hypothesis that they dropped into the ponds from the air and then found their way into the fish. There is the soil and water, and if either of these it is of course ultimately the soil. This is a more reasonable supposition. Books on bacteriology have long lists of species of soil organisms. It is readily conceivable that some of these species, in the earth immediately surrounding the springs, conduits, or ponds of a trout hatchery entered the water and lodged within the body of a trout and found its blood and tissues so favorable a home, that whether or not it had ever been parasitic before, it now became so. It is readily seen that the mouth would be a probable avenue of entrance. The germ having entered the water is apt to be taken in with food of any sort. It is smaller than most of the body cells and can make its way into tissues between these cells. It can enter through abrasions anywhere on the exterior of the fish, through breaks too small to be seen, possibly through the intact skin. Theoretically one bacterium and one trout are sufficient for the start. The rest is easy.

It appears probable then that the original infection was not present in great abundance, but was comparatively dilute. But after occurrence of one epidemic the conditions are very different. When a brood of trout in a pond is affected with the disease, the specific germs must be thoroughly distributed about the pond. Wooden or earth ponds are pervious. They harbor the germs, and afford a permanent resting place in which they not only live but doubtless multiply, feeding upon the organic matter which is retained from uneaten food and excreta from the fish. The infection is now localized in the pond, it has a focus there, is no longer dilute, but is present in strength, and the fate of the next brood of susceptible fish placed in the ponds is almost a foregone conclusion. These ponds are incapable of thorough disinfection.

This brings us to what I may call the wooden pond theory. Wooden, because the ponds have usually wooden linings, but earth or other pervious material comes in the same class with

wood for present purposes. The idea is merely that a pervious pond retains the infection indefinitely and passes it to the fish held in it. I believe no brook trout have been raised successfully in such a pond after this disease has once occurred in it. Now, if these ponds are built of an impervious material, cement, masonry or iron, this source of infection is cut off. Bacterial or other micro-organisms will not penetrate such material and can at most lodge along its surface. Here they may be readily killed by methods of chemical disinfection, which is practically impossible with the other ponds. It is to be understood, of course, that there is no magic in the cement itself to prevent disease any more than in the wooden construction to cause disease. The cement will act merely as a barrier to the invading germs, while the wood or earth on the other hand are their very vehicle. Our pond of masonry or cement then can reasonably be expected to prevent the spread and continuance of a given epidemic. It corals it, so to speak, within a definite space, where it is vulnerable and may be killed by the ordinary methods. I am referring now of course to the germs in the pond but outside the fish. We can be sure of starting in any given case, with a clean, uninfected, or disinfected pond, and if infection enters thereafter it must gravitate from the air, or come down with the water supply.

We must consider briefly that part of the fish cultural water system above the ponds,—the part usually not inhabited by the fish. You will remember I made a distinction between the danger of the primary or original menace of infection and of the secondary or localized one. The former was looked upon as less dangerous but was responsible for the first epidemic, the latter as far more dangerous and almost certain to infect; and implied the continuance or recrudescence of the disease. This distinction corresponds on the one hand to the water supply above the ponds and free of fish, and on the other hand to the pond system itself in which the fish are held. The demarcation is at the point of entrance of water into the pond. Below this line, or in the ponds, the danger of infection is the same as that above plus the localization from previous epidemics. Bacteria probably do not travel up the conduits, so that above this line of demarcation the danger is that which always existed there, namely that some obscure chance or accident may start the ball of disease rolling by

introducing infection into the water. At this point it may occur to you to ask why, if the cement construction is a barrier to infection, can it not be continued up the conduits and into the springs and make the water system impregnable? The objection will as readily suggest itself. As far as the conduits are concerned this would be excellent, but when it comes to the spring that of course must be left sufficiently open to deliver the water. These openings would defeat the main purpose of the cemented spring. It is a case of a little leaven leavening the whole loaf. The cement here might be of some value, but if infection underlies the spring the water would carry it in. If the water entering a cement lined spring could be filtered free of micro-organisms there would be complete protection in association with cement ponds from infection through soil or water. But this degree of safety cannot be attained. As for the prevention of disease by the use of cement or stone, we must count on the application of these to the ponds alone as so nearly covering the whole source of infection as to offer reasonable hope of accomplishing the prevention. This means that the pond infection is so large a part of all the infection to which the trout are exposed, that protection from it will mean protection from disease,—except, no doubt, the occasional outbreak. The danger of an occasional outbreak is a risk which must be assumed. At Northville, during the past June, the fry in the troughs in the hatchery commenced to die of the disease which was among the yearlings in the ponds out of doors. This is the first time in some years that serious trouble has occurred with the fry in troughs, and perhaps the first occurrence of this particular disease in the troughs. At first this seems to militate against the pond theory, for the trough supply water comes directly from a large spring above the ponds. But this spring is practically a fish pond, for trout have been kept there from time to time, and while disease has not been noticed there it is not improbable that it has occurred. There is always considerable loss from such ponds, part of which is due to depredations. But it must be remembered that fish dead or dying from disease would be apt to be quickly appropriated by birds and animals, or to be lost to sight in the vegetation, the conditions in this respect being quite different from the

small wooden ponds where every fish is in plain sight at all times.

I do not forget that the source of disease may be looked for in quite other directions than the one I have indicated. The food would perhaps be the first to come under suspicion. It is very difficult of determination for the food which causes disease is long past examination by the time the disease is manifest. Daily examination bacteriologically, of a large number of rations, while involving a large amount of work, may be undertaken to advantage when the more probable explanation is discredited. Organisms to which the brook trout is susceptible can hardly be habitually present in the livers fed, or the disease would be more widespread than it is.

Thus far in considering the subject it has been assumed all along that the parasitic organism invades the trout from without, that is, is external to the fish. Now it may conceivably be a permanent resident within the trout, even performing some normal function, and not really foreign to it, though I expressed it that way, and when the vitality of the trout is lowered, or the susceptibility increased, under the conditions of domestication, it becomes a virulent parasite and destroys its host. A somewhat analogous instance may be cited in man. The colon bacillus is a normal and constant inhabitant of the human intestine. It ordinarily does no harm and formerly was not reckoned a disease producer. It is now known to be frequently concerned in pathologic process. The intestines of the brook trout of course contain always many bacteria, and it appears that the blood sometimes does in apparent health. The identity and significance of these organisms is little known at present. The question cannot be taken up to advantage until by experimental inoculation a specific bacterium is established as the cause of this trout disease. It will readily be seen however that should this hypothesis prove true the disease is much more serious than at present appears, and that cement ponds will be quite useless in combating it, unless they happen to be more hygienic. The matter of prevention would then resolve itself into a question of hygienic conditions and keeping the broods in a high state of vigor. Presumably this is best accomplished by imitation of the natural conditions,

and with this domestication is largely inconsistent, because there must be considerable divergence from natural conditions.

As for a remedy for the disease, to apply to trout actually affected, I have none to offer. It is not probable that any will be found. In many human infections the best that can be done is to give the patient the best chance possible to fight it out by himself. There are very few specific remedies. The antitoxins are notable instances, particularly diphtheria antitoxin, which is a conspicuous triumph of medicine. These will probably not be applicable to fishes. When a trout shows external signs of the disease, he is doomed, and many are before such signs appear. However I have used formalin three different times in dilute solution as a bath. The idea was that there might be a germicidal action through the gills, but it was scarcely hoped that it could accomplish cures. Formalin is an aqueous solution containing 40 per cent. of formaldehyde gas. The bath contained one-third of 1 per cent. formalin or a little more than one-tenth of 1 per cent. formaldehyde. Fry endured this without injury for about five minutes, yearlings for about ten. On the first occasion there was no immediate falling off in the death rate, but after some weeks the infection subsided and a portion of the brood survived. It was an open question whether or not this was due to the treatment. On other occasions it was applied to fry and the death rate went up instead of down. I conclude that this sort of medicine is useless, and do not believe that any treatment is of any avail. The cure is nothing, the prevention everything.

At one station the disease was checked by the transfer of the trout to certain large earth ponds which contained an abundance of natural vegetation. In fact most of the conditions to which wild trout are subject were supplied by these earth ponds. They were very much larger than the wooden ponds. Now I believe there was more prevention in this than cure. The unaffected individuals merely failed to take up the infection, and the chief factor that enabled them to avoid it was the *dilution* of the infection, and the previous freedom of the pond from infection. It was somewhat like returning the trout to a natural stream. They separate, there is more space between the individuals and there are fewer germs to each cubic unit of water. Many fish within a small space is of course a necessity in domestication. This is a

very important factor in the transmission of disease, perhaps the determining factor in its control. The fish are crowded from the standpoint of disease though not from that of aeration. One naturally wonders whether wild trout ever suffer this disease. The attempt has been made to follow the history of trout distributed from the hatchery, but no evidence of mortality could be obtained. In the wide range afforded by the natural streams lies the safety of the wild fish. Yet it will not be very surprising if the disease is sometimes found in the trout streams.

This remedy, then, is probably a preventive remedy. It is difficult to believe that any with the disease well established could have recovered. It is a success, nevertheless, so far and so long as it is able to check and prevent this disease, and it has done so in the few instances in which it could be applied. But such ponds as these must of course be limited in size and their ultimate infection is extremely probable, if not certain. They will then propagate the disease instead of checking it.

There is a class of predisposing causes. The explanation, or rather supposition, concerning the original entrance of infection regards it as a comparatively rare accident, and attributes it to no factor which could have been readily foreseen and controlled. A number of such factors have suggested themselves as possible explanations of the trouble with the brook trout:—food, water, lack of aeration in the water, in breeding, and the general artificial conditions which may be summed up as continued domestication. Some of these could actually convey infection, as the food or water, and predispose at the same time. But the others are predisposing causes only, where they have any influence at all. They are not efficient causes. The distinction is an important one because on it may hinge the future of brook trout culture. As for inbreeding there is probably no such thing in the sense of close consanguinity in which it is used with higher animals. If water should lack slightly in aeration, if hard water is of any disadvantage, if small ponds without vegetation are unfavorable, none of these things would express itself as an infection. But they could, singly or combined, predispose to such infection, and might be so important as predisposing causes that they determine the attack of disease. But the predisposition and the presence of disease germs must coincide. It is proposed to

bar out the germs. It is hoped that cement ponds will be an adequate barrier. The predisposition will remain. It is hoped that the brook trout will thrive in spite of it.

Until this year, as far as I know, the disease in question affected only the brook trout. Now the Loch Leven has it. But the rainbow in ponds alongside and under identical conditions, has never acquired the disease, and seems to be immune. This is the only explanation I can offer, that of immunity. It is a matter of lack of susceptibility. This is a sufficient explanation for there are plenty of similar cases among higher animals, in which closely related species have very different susceptibility to the same disease. The immunity may not be complete, and the disease may sooner or later establish itself among rainbow trout.

The fact that many places where trout are bred and held in wooden ponds have not experienced the disease is only an apparent objection to the explanation of its cause as here given. It merely means that the germ is not present in the vicinity or has not gained a foothold in the ponds and in the trout. If one were permitted to inoculate these ponds or trout with material from diseased trout it would be surprising if the result were not the establishment of the disease there.

In the light of the facts at present known about the brook trout disease, its infectious nature, the experience of the United States Fish Commission with it, and the general principles that obtain in analagous diseases of the human family, it is submitted that the theory of pond infection is the most probable of the possible explanations of its regular recurrence; and that while impervious ponds are not proven to be the best and only way of dealing with the trouble—experience alone finally settling that—they are worth installing on an experimental basis.

#### DISCUSSION OF PROF. MARSH'S PAPER.

The President: We are greatly indebted to Mr. Marsh for that paper.

Mr. Clark: I think that the people here who have had any experience in the way of fish diseases should relate them and that there should be full discussion of the paper, any questions that may occur to us on this subject being directed to Prof. Marsh.

Mr. Bower: Prof. Marsh rather intimates that where the

trout have access to the earth, or where the pond is filled with an abundance of vegetation, while this is not exactly a cure for disease, it may prevent it, and yet he prescribes as a remedy that we build cement ponds. This of course would cut off access to the earth and prevent the growth of vegetation, and while this might cure some particular form of disease or destroy some particular kind of parasite, might it not also encourage the development of other parasitic forms which the presence of vegetation would have a tendency to correct or prevent?

Prof. Marsh: It is a matter of experience that earth ponds actually did prevent the disease. That is, at a particular station the disease was in existence in a small pond, say an eighty foot pond lined with wood in the ordinary way; a great many of the fish were dying there every day; and the prospect was that in a short time they would all be dead; but we took them and put them into one of these large natural ponds which had been dug out, but which contained no wood, cement or stone in it, and the vegetation grew much as in an ordinary pond. It had all varieties of temperature, being fed with springs, and near the springs the fish could get as cool as they pleased, while at the top of the pond the water was as warm as could be desired, and there was a variety in temperature. These trout did not all die and the disease was checked. I do not think the earth cured any of them that already had the disease but it stopped the spread of the disease. The disease had existed in a pond not much larger than this room, and there was every chance for the disease to spread; but when the fish were put in the large pond they were widely separated and while there were fish that had the disease, no doubt, yet they did not pass it on to the rest and they got well. Now if that could be applied at all the stations where this disease is found and the fish could be turned over into such ponds, it would work well at least for a time, but, as I said in the paper, the infection even of such a large pond as is mentioned is merely a matter of time in my opinion. When the mud at the bottom of the large pond once becomes impregnated with the germs that have been carried over, the large ponds instead of checking the disease will spread it, and when you do get one of those large ponds infected you will never get the infection out; it is much harder to disinfect the large ponds than the small

ones, for you cannot disinfect them with chemicals. The cement pond acts merely as a barrier against infection, and, as Mr. Bower says, it might in some way predispose to other diseases; we do not know about that. It is untried and the experiment must be made. I do not see how it could predispose to some other disease than the one we are trying to prevent.

Mr. Nevin: At our Bayfield hatchery we built a race ten by two hundred feet, and we had such a good stream of water running through, that with all the fish we handle during the spawning season, we hardly lost a trout till the middle of May; but from that time to the middle of June we lost a good many. We held the narrow race responsible for this loss at the time. We now have large ponds but we have the same trouble with them as with the smaller ponds. At the Madison hatchery we have the largest loss of fish in one of our best ponds in point of water supply, while in a small stone pond, with a limited supply of water, we carry more fish than in any other.

Mr. Arthur Sykes: Prof. Marsh, in speaking of the case where they transferred fish from an infected pond to one which was not infected, said the disease abated and that is the experience we have had several times at Madison, that transferring to another pond seemed to stop the disease, and that is true not only of fry but of yearlings.

The President: Do you know whether down in New England among those commercial hatcheries where they use peat for the sides of the ponds, they have had any difficulty with this disease or not?

Prof. Marsh: I have been told that those commercial hatcheries in New England have never had the disease; that they are able to raise brook trout successfully; and I understood that their ponds were much the same as the ordinary wooden ponds except they were of peat.

Mr. Clark: These fish, that Prof. Marsh has been working on were from eggs bought from the eastern hatcheries (the yearlings and the fry).

Mr. Bower: There are only one or two hatcheries that use peat, but they use either peat or wood.

The President: None of them have stone or cement; they

are all natural earth banks or they are wood, and yet they never have the disease.

Prof. Marsh: Of course that seems strange, but there was a time when the disease did not occur in these wooden ponds. The infection has got to occur there after a certain length of time—it will come.

Mr. Brown: I would ask, where they have the wood pond, if the wood was not treated with some kind of paint that made it impervious to germs—creosote or coal tar?

Prof. Marsh: That is practically proposing to make the equivalent of cement. If you can put wood in the ground and make it impervious, well and good, but I do not believe that you can do it. You can make an impervious box or bank above the ground, but if it is in the ground how can you protect it from being heaved by the frost? It would be very difficult, you see, and rather difficult to make it tight. In this climate I suppose it would be upheaved the first winter by the frost, and that is possibly an important objection to the cement or stone ponds; I cannot find where they have been experimented with during hard winters.

Mr. Clark: Was this question brought up by Mr. Brown in regard to the wood ponds, that if they were properly coated with something that that might be a preventive of germs?

The President: Yes.

Mr. Clark: Prof. Marsh has not touched upon that. But the disease now, as he says, has developed in ponds having cement sides and no wood. That helps to carry out the theory that this disease works in. I now have orders from the commissioner to build two ponds in accordance with Prof. Marsh's suggestions, that is, entirely of cement, bottom, sides and ends. The water goes through nothing but cement tile. We thus hope to avoid the possibility of the introduction of germs. Four of our present ponds have cement sides but not cement bottoms, so the theory of the painted wood sides cannot figure in this matter, as cement sides are certainly as effective as painted wood in keeping out disease.

Mr. Nevin: We have never had any loss among the small fry or yearlings, but our loss has been among the largest trout.

The President: Those that have been in the pond longest.

Mr. Nevin: At Bayfield we do not have the loss until the spring of the year. The water goes down to 33 or 34 degrees and as soon as it begins to warm up in the early summer our loss commences. At Madison we have our greatest loss in January and February while in Bayfield it is in May and June.

Prof. Marsh: Mr. Clark's experience is that this disease affects yearlings especially and that he has never had it in the adult crop. The yearling appears to be especially susceptible, but later the disease attacks the fry, and we have never had it in fish over two years old. It comes in yearlings more than in other fish.

Mr. Mathewson: In Connecticut we lost lots of our fry in the troughs before we got them out into the ponds at all—lost them by thousands—and we were using the same water as with yearlings, but we did not lose any of our yearlings. We have not been able to account for this fact.

Prof. Marsh: Was it brook trout?

Mr. Mathewson: Yes, we lost thousands of fry in the trough.

Mr. Titcomb: We have not had what we call an epidemic either at the state hatchery or the national hatchery, but we have had in two or three instances cases where the fry in one trough supplied with water from the supply trough would turn right over and all die, where the fry in the other troughs right next to them would be strong and healthy and go through all right. We could not account for that.

Mr. Mathewson: That was our experience this year.

Mr. Sykes: The change of environment has brought them out all right at Madison. Even a fry that is a little weak, when taken out into the pond receiving water from the hatchery, comes out all right. The change of environment seemed to be what was required.

Prof. Marsh: There was no greater amount of water but more room.

Mr. Sykes: That is true. There was a different bottom, as they were taken from a gravel bottom and put on a mud bottom.

Prof. Marsh: There might be something I suppose in mere change.

The President: This discussion is very interesting to the Michigan Fish Commission, because we have just secured an

appropriation to build a new hatchery, and they have not started it yet.

Prof. Marsh: I would like to ask the gentleman who spoke about Connecticut if he noticed in those fry that he was talking about, the appearance of the dead ones. Did they look like healthy fry?

Mr. Mathewson: They appeared to be perfectly healthy. They seemed to start and go all at once; I took them to the state chemist at Yale college and he could not explain it.

Prof. Marsh: You examined the dead fry and their sides and muscles seemed to be all right?

Mr. Mathewson: Yes, except a little dark streak through the intestines.

Prof. Marsh: No ulcers or sores?

Mr. Mathewson: No.

Prof. Marsh: That might have been a different disease than the particular one that we are discussing.

Mr. Mathewson: This was just as they were beginning to feed—they had been feeding about two weeks at that time.

Mr. Geer: I would like to ask if that disease would affect the hatching troughs also so as to kill the fry?

Prof. Marsh: We have had the disease in fry that were in troughs, but very much more rarely than in the ponds. This summer for the first time it occurred in the troughs. The troughs in the house, as far as protection from germs is concerned, are on just the same basis as cement ponds out of doors. They are painted with asphalt all over and are perfectly impervious. So I explain their infection on the ground of original and rare infection from the springs, and that should be excluded. If you could continue impervious construction up into the spring, it would be advisable to do so, but you cannot do it, so that once in a while this disease will attack trout even in cement ponds under the best conditions, but you can nip it in the bud, whereas with wooden or earth ponds the infection is carried on forever; it rests in the organic material, soaks into the wood, and multiplies in this organic matter which always exists, and disinfection is impossible. But in the cement ponds disinfection can be readily accomplished, and you can start over with your pond perfectly clean. Now if this original infection should occur every year

you are as badly off with cement ponds as you are with wooden ponds, but happily this original infection will probably be comparatively rare.

Mr. Sykes: Where diseased fish are put into another pond they must leave the germs of the disease in that pond.

Prof. Marsh: Yes, sir.

Mr. Sykes: You put diseased fish into earth ponds?

Prof. Marsh: Yes.

Mr. Sykes: Your idea is that the soil becomes polluted with this disease germ, yet in the nature of things that must leave the new pond in the same condition.

Prof. Marsh: It has not done so yet, because it has not had time. The large earth pond would be infected more slowly because of its size.

Mr. Sykes: Your idea is that these disease germs multiply in the soil and do not tend to die out?

Prof. Marsh: In a plain earth pond or wooden pond the tendency is for them to grow. The water soaks in through the boards and there is nothing but a wet mush full of organic material, and they will grow in that, but in a natural pond of vegetation I think there is less chance for it, because it is not quite so rotten down there.

Mr. Sykes: You make a distinction between an earth pond with vegetation and a board pond without vegetation?

Prof. Marsh: Yes.

**THE STUDY OF FISH DISEASES.**

BY CHAS. G. ATKINS.

It is not my purpose in this paper to present an exhaustive discussion of the subject, nor even a general summary of the results of investigation in the field. I shall attempt the humbler task of citing a few passages from my experience, prefaced by some general observations which I trust may commend themselves to your approval.

While for the complete elucidation of the nature of the diseases of fishes, as well as those of the human race, we must call to our assistance the professional microscopist and the professional pathologist, it is not at all necessary that the lay fish culturist should lie on his oars while epidemics or diseases of more limited scope sweep away his charges. It is quite within his province to observe, to record, to experiment, and quite possible thereby to learn very much about these diseases and the means of their avoidance, control or cure. But it is quite essential that any one attempting such studies should adopt the scientific spirit, and the scientific spirit demands the exercise of great earnestness, great alertness, great patience, great perseverance, and above all great self-control. And when I say self-control, I mean especially control of the opinion, restraining one's mind from making itself up prematurely,—on insufficient data. To put it in more popular language, one must not jump at conclusions.

I may be pardoned for digressing here far enough to say that in the course of a lifetime spent in this pursuit, I have often had occasion to note that the bane of fish culture has been the disposition to jump at conclusions. It is a trait of human nature. Hardly one of us is free from the foible, and hardly one of us but is suffering today from the effects of some mistaken conclusion reached in the past by disregarding some pertinent facts that, if not plainly in sight, might have been easily brought to view by a little more of persistence in the search. Private fish culture and public fish culture are suffering from it today. There has been too little of the scientific spirit. And science, I

beg to remind you, does not consist essentially in a knowledge of the Latin names of fishes or the minute anatomy of an insect. Such things are not to be despised, but they are only aids and means to something of greater importance; and a man may possess either or both of them and yet be less scientific than a humble layman who holds his eyes and his mind open for the acquisition of new facts, and faithfully restrains his opinions from crystallizing on any half-knowledge.

I think that the importance of this subject is generally underestimated. It is not impossible that many fish cultural operations have been brought to naught by the action of unrecognized diseases; nor that definite diseases have been the cause of many of those great fluctuations in the numbers of wild fishes that history has recorded.

Hardly any of the great commercial fishes have escaped fluctuations, either general or local, which have been of great moment to mankind. Not only to the fresh-water and anadromous species, but to those of the ocean, will this statement apply. For instance, the sudden disappearance of the tile fish some years ago from the grounds where it had been abundant, followed after years by its reappearance; the fluctuations of herring on the coast of Sweden; of the blue fish and menhaden on the coast of New England. Some of these phenomena may be accounted for in other ways, but the tendency of discovery is in the direction of some destructive enemy or disease to account for very sudden decrease of species.

An official report lying before me gives a list of 104 different diseases from which human deaths occurred in the state of Maine during the seven years from 1892 to 1898. Is there any inherent reason why fishes should not have as many diseases as men? Observation has already gone far enough to indicate the probable existence of a very considerable number of diseases among the fishes we cultivate. At the Craig Brook Station of the United States Fish Commission there have been observed perhaps a dozen different diseases affecting salmon and trout, the majority of which still await sufficient study to warrant us in naming them or assigning definite causes. A rough list of them, not pretending to be complete or exact, is as follows:

1. A spot disease of the sac, appearing in the egg or after hatching.

2. A disease appearing when the sac is about half absorbed, characterized by a whitening of the sac, which begins in irregular white blotches: our most serious disease, known locally as the "sac-epidemic:" attacking several species.

3. Another disease of the sac stage, characterized by a strong upward curvature of the trunk.

4. A disease of the dorsal fin of a salmon in the first summer of its life, in which the fin is eaten away at its edges until more than two-thirds gone and then heals up perfectly, with no other apparent injury to the fish.

5. A similar disease attacking the fins of young rainbow trout and steel heads, especially the caudal fin, which is completely eaten away, together with the adjacent flesh, until the extremity of the back bone is bare.

6. Fungus on the egg.

7. Fungus on fry two to four months old.

8. Fungus on adult salmon.

9. Monstrous enlargement of the genital organs of salmon in their second year.

10. Trematode parasites on young lake trout.

11. An epidemic attacking salmon two or three months old.

12. An epidemic attacking salmon four or five months old.

13. A sort of epilepsy in which salmon two or three months old have temporarily lost their balance.

One of the most interesting cases was that of the young lake trout attacked by parasites in 1896. These fish had been hatched from eggs received from Northville and had apparently been thriving until about the middle of July, when there was a slight increase in the mortality. A week later the rate of mortality had trebled and by the 10th of August it had increased more than tenfold. At first it was thought possible that the mortality was due to fungus, and the fish were treated with salt. No benefit resulting, the microscope was brought into use and behold the fish were swarming with living, active parasites, which moved about over the fish after the manner of loop-worms or leeches,

apparently the creature that has been described under the name of *Gyrodactylus elegans*. In hope of destroying the parasite, the salt treatment was continued, but it was found at last that the parasite could endure quite as much salt as the fish itself. Mr. Seagle at Wytheville, has since discovered that this parasite is readily destroyed, with entire safety to the fish by a bath consisting of one part common cider vinegar, three parts water. The mortality went on until the sufferers had shrunk from 39,000 July 1st to 10,000 in November, and the survivors were fish of low vitality, of whom probably not one ever grew up.

No unusual mortality occurring among the fishes of other species reared alongside the lake trout, and under the same circumstances, it was a puzzling problem why the *Gyrodactylus* had made such an attack on the lake trout. The theory was at once suggested that the parasites had been imported along with the eggs, and the occurrence of a few specimens on other fishes in neighboring troughs might easily have been accounted for on the supposition of accidental transfer from trough to trough; but the discovery of specimens on wild fish caught in Craig Pond at the head of Craig Brook, more than half a mile distant, with intervening falls of great difficulty, indicated that the parasite was native to our locality, and suggested that something extraordinary in the condition of the lake trout invited the attack. Indeed it seems not impossible that the fish died from some other cause, —some unknown disease,—and that the parasites had merely been feeding on the disintegrated tissues. Verily, this is a case in which judgment must be suspended.

The most destructive disease that has ever come under my observation was the sac-epidemic which raged several seasons at Craig Brook and in 1892 destroyed 99 per cent. of our young Atlantic salmon. I call it "sac-epidemic" because it raged during the sac stage of the fry, and because the most obvious symptoms were connected with the sac. It would appear about midway of the sac stage, while the sac was still less than half absorbed. In water of constant temperature, such as pure spring water, I imagine that the disease would appear by the first quarter of that stage. Our water is very cold at the time of hatching —about April 1st,—and gradually warms up, so that the development of the embryo is at first very slow and later comparatively

rapid. The fry hatch about April 1st, and before the end of April, in epidemic years, the mortality suddenly increases, and it is found that the sacs of the fry are blotched with white. These blotches spread until the sac is nearly all white, especially the apex. When it reaches this stage, the fish dies. Other symptoms are apparent listlessness, indifference to light and outside movements, and in consequence a scattering about on the bottom of the trough instead of crowding into the dark corners as is the normal habit of the fish.

This disease was first observed in 1890, when it carried off 30 per cent. of our fry, including Atlantic salmon, and land locked salmon, but did not touch Loch Leven trout or Swiss Lake trout. It was, however, observed that not all of the Atlantic salmon were attacked (or at any rate suffered noticeably) and in the lots where it did appear its destruction was quite uneven, in some cases barely noticeable and in others wiping the lot completely out.

It is our practice at the Craig Brook Station to preserve a careful record of the character of every salmon handled at spawning time, to keep the spawn taken each day separate from that of every other day, and to keep up the distinction with the fish hatched through the entire season, and indeed as long as the fish remain with us. In some cases, as, for instance, a female salmon of remarkably large or remarkably small size, or an unhealthy appearance of fish or eggs, the product of each fish is kept by itself. The position of each family in the hatchery is also noted. When hatching time approaches, the large lots of eggs, (or families), are divided up into smaller lots of one or two thousand each,—sometimes larger—and the origin, location and history of each of these minor lots is recorded. When therefore, one of our fishes dies, or does anything else remarkable, we are able to follow back its record to the day when as an egg it rattled into the pan at Dead Brook, and sometimes to the identical mother that dropped the embryo and the identical father that gave the initial impulse of life. These records sometimes appear, even to us who keep them, as somewhat laborious and fussy, but in this instance of the sac-epidemic of 1890, they have enabled us to draw some very interesting conclusions as to the influence of heredity in this disease.

It happened that the troughs intended for the summer use of these fish were not quite ready when the eggs were laid out in March to hatch, and they were therefore crowded for hatching into a smaller number of troughs which were for the purpose divided into compartments by fine, close-fitting wire screens. The water, passing first over lot A would nourish in succession lots B, C, D and so on down the trough.

One of the most noticeable results was that the losses were very unevenly distributed in the troughs. For instance, Lot A, at the head of the trough, might be half destroyed, Lot B totally, and Lot C almost wholly escape. When all the results were correlated, it was found that the mortality ran in families, some families being utterly destroyed, some suffering moderately, while in others the mortality would be so light as to warrant the conclusion that the epidemic had nothing to do with it.

Now what shall we say? Did the germs of the disease come to these little fishes from their parents, or did they inherit merely different resisting powers, so that, though all of them were assailed about equally by the disease-germs, some of the families had a hereditary ability to ward them off, while others succumbed? The answer to this question must await deeper study than we have yet been able to give.

Among other deductions to be drawn from the same data is one as to the infectiousness of the disease. Infectiousness would cause the lots occupying the lower parts of the troughs to receive the disease from those lying above them; but the record shows that nothing of the sort happened. The rate of mortality of the lower lots was wholly uninfluenced by the condition of those above. It was therefore not an infectious disease, and did not spread from lot to lot.

It was further observed with reference to this disease, that the occasion of its first appearance was coincident with a great reduction in the proportion of lake water in the hatchery supply. A coffer dam had been constructed at the outlet of Craig pond (or lake) which in the spring shut off the lake water and compelled us to use a much larger proportion of spring water. A second attack in 1892, was coincident with a very low stage of Craig pond and brook, caused by a scanty fall of rain and neglect of storage measures. It therefore seemed reasonable to turn

our suspicions in the direction of the spring water. Measures were taken to insure a fuller supply of lake water during the stage following and immediately preceding hatching, and this has been attended with favorable results.

I earnestly recommend all fish culturists to keep complete records, even to the verge of fussiness, so complete and exact that they can be intelligently referred to after the lapse of many years. Besides many other uses, they may serve to solve some of the puzzling problems connected with the diseases of fishes.

#### DISCUSSION OF MR. ATKINS' PAPER.

Prof. Marsh: The reference that the writer makes to epilepsy in fishes recalls to my mind an interesting instance of that disease occurring in the Snowy Grouper (*epinephelus niveatus*) in the aquarium at Washington. These fish had a peculiar attack of what one might term epilepsy. They became frantic and dashed about the aquarium at a tremendous rate. They looked as if they would die, and apparently they did die. Their mouths were wide open and gills distended; but they came to life again; and every now and then the fish in this aquarium would undergo the same experience, and did for all the time that they were there; and this was repeated a number of times, and this family of Groupers seems to be subject to such attacks of fits of epilepsy, and it is interesting to notice it in Mr. Atkins' experience.

Mr. Clark: Just before the reading of the first paper the attention of the superintendents was called to the importance of this subject. Its discussion has been very interesting to me and has brought out a great deal that is good.

General Bryant: Dr. Birge, of the State University, is studying with the greatest care and watchfulness all indications of disease that occur in our hatcheries, and I was in hopes that he would be here today—he may be here tomorrow—he is now president of our university and is so loaded down with administrative cares that he is compelled to be absent today at least.

Mr. Bower: Mr. Atkins enumerates in his paper thirteen different diseases. It looks to me as though the trout culturist has a pretty hard row to hoe, and it seems that new diseases are coming up all the time, or at least old diseases under new names,

and it all emphasizes the necessity for great vigilance on the part of the fish culturist and the constant employment of a scientist to work on these subjects.

General Bryant: I secured legislation in this state some years ago to make the professor of biology in our university ex-officio a member of the Fish Commission, and the legislature fell in with the suggestion very readily. We considered it a very wise step to take at the time and experience has justified it.

## **THE PROPAGATION OF MUSKELLUNGE IN WISCONSIN.**

BY JAMES NEVIN.

The muskellunge is the largest of our fresh-water game fish, and as he was endowed by his creator with great size, in like manner, he was given liberally of those excellent game qualities which appeal to the sportsman. From a gastronomic standpoint he has few equals among fresh water fish. To the frequenters of the great fishing resorts of Northern Wisconsin there is no attraction so great as the capture of this king of fresh water fish. His great size, vigorous game spirit, and superior table qualities combine to make him a prize worthy the effort of the most exacting disciple of Walton. Many anglers come for hundreds of miles with the one idea of capturing this fish, and few sportsmen are content to leave our northern waters till they have put at least one of these fine fishes to their score. The fish is worthy all the effort that is given to its capture; for, to say nothing of the pleasurable excitement incident to catching it, it has a table value not excelled by any other large fish of our fresh waters. By some it is properly ranked in quality next to the salt water salmon.

For many years, since the wilderness of Northern Wisconsin was opened by the railways and by lumbering operations; with the advent of the comforts and conveniences which the railroad takes into a new country, and the encroachment of the settler and summer hotel on the primitive banks of our northern lakes, the pursuit of the muskellunge has been constant and relentless. Its utter extermination has been well nigh accomplished in many of our lakes to which it is indigenous; and nearly all of our waters have been cleared of this fish to such an extent that its future has become a matter of much concern to sportsmen, fish culturists and others interested in keeping our waters well stocked with superior game fish.

Under these circumstances it has devolved upon the State Fish Commission to attempt the preservation and increase of

muskellunge in our waters, and it is much to be regretted that this work was not begun several years ago.

The artificial propagation of muskellunge was first taken up by the Fish Commission of the state of New York some twelve years since, and in 1891 that state made the first successful hatch of this species, planting over 1,000,000 fry. Since that time the Fish Commission of New York has planted several millions of fry of this species in Chautauqua Lake and other waters with unqualified success.

The Commissioners of Fisheries of Wisconsin began the propagation of muskellunge during the spring of 1899 in connection with the work of collecting wall-eyed pike ova; and we believe we are now in a fair way to successfully hatch and plant the fry of this fish in large numbers.

The chief difficulty we encountered in this work was to catch the fish on the eve of spawning; as we found that the large fish would not stand confinement. In the beginning we could not get a sufficient number of ripe male fish. We tried holding the fish in pens, expecting that both the male and female thus confined would ripen in a few days, but in this we were disappointed.

Last year we caught the fish in pound and fyke nets and confined them to a large dummy or pocket, 20x22 feet, 10 feet deep. We were quite sure that we could hold the fish in this way until the ovaries ripened, but we were again disappointed; as we found the ova would cake in the fish and we were obliged to liberate them without securing the eggs we expected.

During the spawning season just past we made a large pen in a thoroughfare between two lakes, in a current of flowing water, in which we held the unripe fish. We found this pen a great improvement over the dummy for this purpose. The unripe fish placed in the pen matured the ova in due time and we were enabled to take spawn and milt from most of the fish secured. After spawning, the fish were returned to the water alive.

If you are searching for the spawning beds of muskellunge you should look where the logs, stumps and drift wood are the thickest. There you will find them, in season, attending to their procreative duties. They approach their spawning grounds in pairs and spawn in shallow water or flowage where dead limbs,

logs, and brush have accumulated as the result of flooding for logging purposes or otherwise.

To catch the fish as they approach their spawning grounds is the strategy employed by the fish culturist; for it would be impossible to set a net where they spawn. For this purpose we now use only fyke nets, and as the fish are taken from the nets each day, if unripe, they are transferred to the retaining pen until such time as the spawn may be taken from them.

It is not altogether an easy matter to collect a large number of muskellunge from our waters for spawning purposes; as it is necessary to cover considerable territory with our nets, setting them on the approaches to as many spawning grounds as possible. Many fish caught in this way are transferred four or five miles from the point where they are caught to the retaining pen.

In transporting the fish from point to point we use large live boxes (so called) sixteen feet long, two feet wide and ten inches deep. These boxes are made scow shape to facilitate towing them. The bottoms of the boxes are made of slats, nailed two inches apart, giving abundant circulation of water and enabling us to safely transport the fish in tow of a row boat to any reasonable distance.

During the season just past we secured 190 muskellunge from which we took 1,200,000 eggs; one female, weighing about forty pounds, producing not less than 225,000 ova. A quart measure will contain about 80,000 muskellunge ova.

Unlike most other fish, the eggs of the muskellunge do not harden after being taken from the fish but remain soft and flabby until hatched. With water at a temperature of fifty-two degrees the eggs hatch in about ten days, and about fifteen days are required to absorb the food sac.

Heretofore, we were not in position to try hatching muskellunge eggs in jars. This year our work was conducted in the vicinity of the Minocqua Hatchery, and I placed part of the eggs in Chase hatching jars at this station. The remainder, being more than half the eggs, was put in hatching boxes and sunk in some four feet of water. We hatched a very small per cent in boxes, but were more successful with the eggs incubated in jars. Just before the eggs began to hatch, we took them from the jars and placed them on trays made of fine wire-cloth. This was

done to prevent the young fish smothering; for I found that the fry would not make their way out of the jars unaided on account of the comparatively large umbilical sac.

The fry when first hatched are of a light color and seem to adhere to the side of the tank, box or tray or any other object with which they come in contact. Those that we hatched were strong and healthy. They grew rapidly, and in their development exhibited their wild nature and the instinct of self preservation by quickly darting off to hide when alarmed by a person approaching the tank in which they were confined. We retained part of them until they were four weeks old and at the end of that time they were an inch and a quarter long. We fed them on young pike which seemed to be a suitable as well as very acceptable food.

We planted 500,000 fry.

I believe we are justified in claiming that our work in planting muskellunge fry during the past two years has shown results of a substantial nature. In the Minocqua waters, where we planted the fry hatched the first two years, more small muskellunge weighing from one to three pounds have been taken during this season than were ever taken before from those waters in the same period in the memory of the oldest guide or resident. We are gratified by the results of our first efforts in this work and entertain large hopes for the future. Already, in fancy, I see our lakes again teeming with this splendid fish, and the value of fish cultural work once more conclusively demonstrated in our waters.

Numerous lakes in Northern Wisconsin, the habitat of this fish, afford an extensive field in which to work, and, when once well stocked, these waters will be a source of abundant revenue to the state; for no other fresh water fish is so attractive to the sportsman and summer tourist.

#### DISCUSSION OF MR. NEVIN'S PAPER.

Mr. Bower: How long were the fish held in confinement before yielding up their ova?

Mr. Nevin: Some of them a week or ten days.

Mr. Bower: Our practice has been to catch the fish, spawn them and let them go as quick as we could.

**EXPERIMENTS IN LOBSTER CULTURE.**

BY DR. A. D. MEAD.

There is, in the life of the lobsters, a definite, well-marked period beginning when the eggs are hatched and ending when the young have shed their shells three times and have reached the fourth stage of development. During this period the young are very poorly equipped, either in structure or habits, for protecting themselves against their enemies or from escaping from them. They swim about slowly and aimlessly in the water, an easy prey to shrimps, fishes, and other animals; they lack the hard shell, the protective coloration, and the swift movements common to most small crustacea; indeed, they do not have even the sense of fear which might lead them to avoid danger. During this period of life there is, as might readily be inferred, a very great mortality.

When, however, the skin has been shed the third time and the lobsters have entered the fourth stage, there is immediately an almost miraculous change in their habits and structure. In many respects the difference between the fry in the third and fourth stages is far greater than between animals belonging to different orders, and the change may be compared to the metamorphosis of flying insects from their larval to their winged condition. In the lobsters, however, the direction of the change is the reverse of that in the insects. They tend to quit their swimming habits, except for purpose of changing position, capturing prey, etc., and become adapted to life on the bottom. They crawl over the bottom, hide under shells and sea-weed and, if these objects cannot be found, they even burrow in the sand.

A brief statement of one experiment will illustrate the suddenness of this change of habit. Three hundred specimens recently moulted into this stage were put into a car which had gravel and stones in the bottom. Within ten minutes not a single specimen was in sight.

Not the least remarkable of the altered characteristics of the fourth stage is their mental attitude. Upon entering this stage

they are born again, they know good and evil; for the first time the sense of fear is evident, and they retreat from danger; there is, in short, a purpose and direction in their activities which was not apparent in the three earlier stages.

The suddenness and completeness of these changes so conducive to the safety of the lobsters gives much practical and economic interest to the problems of rearing the young through the critical period. The solution of these problems would mean a great advance in the efficiency of general propagation of lobsters, and would be the first step toward artificial lobster culture. With this in view a series of observations and experiments have been conducted during the past three seasons by the United States Fish Commission at Woods Hole, Mass., and by the Rhode Island Commission of Inland Fisheries at Wickford, R. I.

The problems in question can be arranged conveniently under five heads as follows:

1. What changes in structure occur in the early development?
2. What is the duration of the first three stages?
3. What are the general habits of life in the first four stages?
4. What is the best method of supplying food?
5. What is the best means of protecting the fry in the first three stages?

1. What changes in structure occur during the early development?

An excellent account of the structural changes from the egg to the fourth moult is to be found in F. H. Herrick's monograph of the lobster, and it will hardly be necessary to discuss them in this paper.

2. What is the duration of the first three stages?

The average period between hatching and reaching the fourth stage for the experiment at Wickford was a little over twelve days. In each experiment the average duration of the first three stages, meaning the interval between the time of hatching and the day upon which the largest number entered the fourth stage, varies from nine to sixteen days.

In experiments conducted at Wood's Hole the time required for these moults was considerably greater; of one lot, hatched May 23d, the fourth stage was reached by a few only on June 12th, after an interval of twenty days. Indeed, on the twelfth day (the average time of reaching the fourth stage at Wickford) none had reached even the third stage at Wood's Hole. The explanation of the variations in the length of time required for the first three stages probably lies in the difference in temperature of the water—the colder the water, the slower the development.

3. What are the general habits of life in the first four stages?

Allusion has been made already to the swimming habits of the fry in the first three stages and to the sudden change to the crawling habit when the fourth stage is reached.

The habit of shedding the skin begins when the lobsters are two or three days old and continues throughout life. The intervals between successive moults grow longer as the age increases. It has already been stated that the first three moults occur, in about twelve days, on the average, at Wickford. There is much variation, according to different conditions. Late in life the periods are longer, and the adult may not shed more than once a year. In the first moults, as in the succeeding ones, the process is the same, the old skin being split across the back, between the thorax and the abdomen, and the body worked out through this opening, leaving the cast skin otherwise intact.

The actual process of moulting usually occupies only a few minutes, but not infrequently something goes wrong and the struggle is quite prolonged. Often the lobster dies in the process, and the period of moulting is at best a very precarious one in the life of the lobster, whether in the young stages or in the later ones.

No animals, with the exception of typhoid convalescents, are more voracious than newly-hatched lobsters. They feed normally upon all sorts of minute organisms such as copepods, diatoms, etc., and will readily eat some kinds of flesh, if chopped into fine pieces and kept suspended in the water where the fry come in contact with it. Apparently they do not distinguish food sufficiently well to go to it from any considerable distance, but take

what they come in contact with ; and as they are continually moving about in an ocean full of organisms, they must but rarely want for food.

The experiments in rearing the fry through the critical period have demonstrated that the chief difficulties to be contended with are, first, that of supplying proper food ; and, second, that of furnishing adequate protection.

4. What is the best method of supplying food ?

When a large number of fry are kept in an enclosure, the natural food supply consisting of other organism, is of course not sufficient in quantity and other food must be introduced. Some method must be resorted to, which will provide the food in greater quantities and with greater certainty. The fry decidedly prefer an animal to a vegetable diet, and, while shrimp can be fed satisfactorily on bread, the lobsters will not eat it.

One of the best foods is lobster liver, which is readily shaken into minute short filaments. At the present price of lobsters this diet is rather too luxurious to be used on a large scale, and furthermore the experiments seem to indicate that it does not always agree with the fry. Shredded fresh fish is fairly good, and very satisfactory in the later stages. The best food so far discovered is the soft parts of clams. The bodies of the clam are cut out and chopped into fine pieces in a chopping tray and then thrown into the water.

There is one habit of the fry which makes the question of ample food supply especially important, their atrocious cannibalism. From the moment they are hatched, throughout the early stages of life their affection for one another takes this disgusting form. The only way to prevent them from destroying one another is to give them an abundance of food, and in such a manner that they will take it in preference to other lobster fry.

5. What is the best means of protecting the fry during the first three stages ?

There are two main difficulties in the way of providing a suitable enclosure for the fry which will allow them sufficient freedom, and which will at the same time confine them and protect them from their enemies. The fact that the young fry swim about and are carried hither and thither by the currents consti-

tutes the first difficulty, for when they are placed in an enclosure provided with a screen which will allow a free circulation of water from the outside, but shuts out the enemies, the fry are carried against the screen and die. The second difficulty is quite as serious and is due to the fact that at certain times the fry have a tendency to leave the surface and sink to the lower depths.

The endeavor was made to rear them in large cars, such as were used at Wood's Hole for holding cod, but provided, of course, with screen sides. This and other similar experiments failed, because the lobsters would be carried against one side by the tide and there gradually sink to the bottom, where they became foul with accumulated silt and unused food and were also apt to meet with death in fighting one another.

The apparatus which promised the best results was first tried by Prof. Bumpus in the summer of 1899. This consisted of large square bags made of scrim, fastened to a float, and weighted at the lower corners. The action of the tides and winds tended to keep the sides and bottom of the bag in constant undulating motion, and thus prevented the fry from lying long in one place, if they were inclined to sink.

This was the method which was almost exclusively used at Wickford during the summer of 1900.

After making numerous experiments and watching the results for about five weeks, we gradually came to the conclusion that the secret of success in rearing the young lobsters was to keep the water in continuous motion. This accomplishes two things: it prevents the fry from settling into pockets to smother or devour one another, and it keeps food in suspension so that the fry can obtain it.

To prove the correctness of this conclusion with the material and apparatus at hand, it was decided to experiment with lobsters which were at that time in small bags. Accordingly the force of the laboratory was divided into watches, and the water in the bags was henceforth stirred with an oar continuously for a week. The result was ample proof that the conclusion was correct. One of the most encouraging results of this method was the clean and healthy appearance of the fry in all stages. The continual stirring prevented the accumulation of parasites found on the body of nearly all of the specimens in the other lots.

Such good results led us to follow up this experiment with others, working upon the same theory, namely that the water should be constantly stirred. To do this a mechanical device has been contrived which takes the place of the oar.

This apparatus, which was put into operation at the beginning of the present season at the floating laboratory of the Rhode Island Commission at Wickford, has proved to be very efficient and a brief description of it may be of interest.

Cylindrical cages, about five feet long and four feet in diameter, made of fine meshed netting were used to contain the newly hatched fry. On the inside of the cage near the bottom was set a two bladed propeller which could be rotated by a vertical shaft. When the propeller was slowly rotated the water was forced gently upwards and the fry, together with particles of food, were kept constantly suspended. In our experiments twelve of these apparatus were operated by a small gasoline engine. The propellers were kept constantly in motion day and night throughout the season. When it was necessary to change the lobsters from one cage to another or to put in a new experiment any of the propellers could be easily thrown out of gear.

The results obtained by the use of this apparatus were certainly very gratifying to anyone who is at all acquainted with previous experiments along this line. In order to ascertain exactly what proportion of the fry could be reared, they were carefully counted one by one at the beginning and at the end of each experiment. From 1,000 to 5,000 of the newly hatched fry were put into one cage and the percentage reared to the fourth stage was in no case less than sixteen except in one case when the bag was torn and the fry escaped. One experiment yielded 34 1-2 per cent., one 40 per cent., and one of the later experiments 50.6 per cent.

Though a comparatively small number of experiments were tried a total of 8,996 lobsters in the fourth stage were obtained. These were placed in cages with sand or gravel bottoms for they no longer needed attention when provided with a place to burrow or hide and enough to eat.

A number of lobsters hatched last year were carried over winter in similar sand cages and are now from one and one-half to three and one-half inches in length.

As a conclusion drawn from these experiments I think it may be asserted not only that we have discovered the right principle in the solution of this most difficult part of lobster culture but that the problem is actually solved. For in view of the enormous mortality of the fry in the early stages, it would be conservative to say that even ten lobsters in the fourth stage are of more significance in lobster propagation than 100 lobster fry newly hatched, and a yield of 30, 40 or 50 per cent. is better yet.

## **PRACTICAL HINTS ON FISH CULTURE.**

BY DR. JAMES A. HENSHALL.

In the conduct of any operation the smallest matters are often the most important, and too much care and study can not be devoted to seemingly unimportant details. Very often, also, the simplest devices give better practical results than those of more elaborate and complicated structure.

In fish culture, especially, is this true, and the more we endeavor to follow the methods of Nature, and rely on the simplest means to that end, the greater will likely be our success. Therefore, while the following suggestions may embody nothing not already known to some or all fish culturists, they are none the less true and worthy of consideration.

### **AERATING SCREENS.**

To begin with the ovum or egg—air is just as necessary to the well-being and development of the embryo as water. In the running water of streams there is air enough for the necessary aeration or oxygenation of the embryo, but in spring water, as it issues from the ground, there is very little, if any, free air.

In fish hatcheries air is furnished usually by a horizontal aerating screen at the head of the trough, being simply a wooden frame with a bottom of perforated tin or zinc. This is all right in theory, but in practice I have found that the small holes in the sheet of tin, being cut very smoothly, do not permit a flow of water through each and every hole as one might suppose. A film or diaphragm of water is thrown over many or most of the holes, preventing the water from passing through, under the pressure of water usual in most hatcheries. Under these circumstances there may not be sufficient air furnished to the ova or fry, as the case may be. At all events it is well to give them the benefit of the doubt.

After being convinced of the inefficiency of the aerating screen as usually made, I devised one that fully meets all requirements. It is constructed as follows: A piece of soft roofing tin of the desired size is marked with lines an inch apart, both ways

of the sheet, and tacked on the frame. Where the lines cross, at right angles, a hole is made with a six-penny wire nail, from the inside of the screen. Thus in a screen of ten by twenty inches, inside measurements, there will be 200 holes. In driving the nail through the tin a shallow dent or depression is made around each hole, while on the under side the hole has a ragged or broken edge.

The simple driving of the nail produces just the conditions that are needed. The water naturally gravitates into the *umbilicated* margins of the holes, and passing through, is broken up by the ragged edges below, imprisoning the air as it falls into the trough. We thus have 200 broken streams of water, the most efficient system of aeration that can be devised, and the most simple. Where the screen is made of the perforated zinc or tin of the shops, the water pours through but a portion of the holes, as before mentioned, and moreover has a tendency to cling to the smooth under surface of the screen bottom, until the water from several holes coalesces, and by its added weight finally drops into the trough in streams of unequal sizes. This condition of affairs is patent to any one who has interest or curiosity enough to examine into it.

I consider the commercial perforated zinc or tin a delusion and a snare for any purpose whatever in fish culture. For foot or guard screens it clogs, for reasons before given, and the smooth round holes are a constant temptation for fry to worm themselves through, whereas by using brass wire cloth the flow of water is free and unobstructed, and fry are not so apt to attempt to pass through it, and would fail to do so if the mesh is small enough.

#### FEEDING FRY.

I wish to call particular attention to the remarks of Mr. W. T. Thompson on the subject of feeding fry, which may be found in the proceedings of this society for 1900, pages 143-146. I wish to indorse and emphasize what he says concerning the feeding of fry before the yolk-sac is absorbed. I first adopted the plan of feeding grayling fry as soon as hatched several years ago, and afterward trout fry in a similar manner. My plan is to feed the bloody water from finely ground and screened liver, by placing it in the horizontal aerating screen at the head of the

hatching trough. While no particle of food may be apparent to the naked eye in the bloody water, it is there, nevertheless, and it is carried along with the water at the bottom of the trough, where the fry soon learn to appropriate a part of it as it floats by them. Coral polyps and other marine invertebrates that are not free swimmers depend entirely for their food on the passing current—food that is not visible to the naked eye, but shown by the microscope to exist in great quantity.

By this early feeding of fry the nourishment contained in the umbilical sac is augmented, and when the sac is absorbed and the alevin becomes a free-swimming animal, it has become accustomed to the liver water, and has acquired a taste for that kind of food. The subsequent surface feeding of liver emulsion then becomes an easy matter. The plan of feeding fry before the absorption of the sac is especially demanded where spring water is used, as it contains no natural food, unless it flows a long distance before entering the hatchery. Where spring water is replaced by stream water as soon as hatching is completed, or where stream water is used entirely, and where, consequently, there exists much natural food in such water, the early feeding of fry is not so imperatively demanded. But if considered in view of the subsequent surface feeding of liver emulsion, which is rendered easier by an early acquired taste for it, as mentioned, it would not be amiss to practice the plan in any case.

#### DISCUSSION OF DR. HENSHALL'S PAPER.

Mr. Clark: I think that it is now generally understood that all trout breeders commence feeding their trout before the sac is absorbed. They go still further than that, and I think most of the superintendents and those who are distributing trout, deposit them in the streams before the sac is gone. To deposit trout in a stream just after the sac is entirely absorbed, is a case of planting fish in streams to die.

Mr. Titcomb: We formerly planted our fry before the sac is absorbed and before the snow water is out of the stream. We would put them in some times, and I have done so a great many years ago, when our team was carried over the hill on top of four or five feet of snow, on a crust that would sustain horses and everything, and then when we got to the stream, we would slide

the tank down on the crust and get to a hole where there was enough current to keep it open and there deposit our fry. I do not believe in that method, although I know that the fry just before the sac is absorbed are more easily transported than just after. I do not believe in planting the fry just after the sac is absorbed. I agree with Mr. Clark on that point. Therefore we keep our fry until they have been fed for six or eight weeks at least, before planting them.

The President: After the sac is gone?

Mr. Titcomb: After the food sac is gone. Then you have got nice strong little fishes, well able to take care of themselves. The streams have then reached their normal conditions also. We begin planting the latter part of May and we plant, you might say, right through the summer. We are shipping all the month of June and into July. There is an intermission through August, and we begin to ship our fingerlings in September and carry shipments right through October, but we cannot in Vermont, with success, plant fry before the sac is absorbed.

Mr. Clark: There is no chance for argument between us. I say that if the trout are to be planted as fry before they are fed at all, they must be planted just before the sac is absorbed. If given any artificial nourishment whatever, the longer the fry are fed the better is their condition for planting. Fry that have been fed only a week or two should not be liberated. Those having taken food two months or more are decidedly superior for planting, the younger fry having failed to acquire in a week or two sufficient growth and strength.

Mr. Titcomb: I think I misunderstood you in the first place.

## THE QUALITY OF THE WATER A FACTOR IN REARING TROUT FRY.

BY C. C. WOOD.

In rearing Brook Trout the temperature of the water is usually the first important item to be considered. However the *quality* of the water is also of great moment, and many who have attempted to raise this fish have failed because the above item had not been sufficiently considered, even if given a thought in an intelligent manner.

What is the *quality* of water necessary to successfully rear this fish? A general answer might be, water that is pure and cold; and this in many cases would prove correct.

But in what does the purity of the water consist?

Will analysis determine whether the water is suitable for the purpose or not; were it pronounced pure?

I think that in many instances an analysis will prove little, for while nothing may be detected injurious to the fishes it may be found upon trial that the supply lacks much of the life-giving properties necessary to the health of the fish. Again water of the utmost purity may be entirely unsuited to the trout, while that from a pond or lake, seemingly unfitted almost for common use, if of low temperature, as during the colder months of the year, might furnish a splendid supply for the nursery ponds until warm weather.

In speaking of this subject I would like to consider the difference, which no doubt many of you have noticed, in the quality of the water from springs or streams, starting at no great distance from each other. While on one the trout may be healthy, do well and grow rapidly, perhaps on the other, but a few rods away it will be found impossible to make them live after they have commenced to feed. And yet both waters may be pure and cold.

Let us consider that the water has had sufficient aeration, that the pools are not over-stocked and that the fish are treated the same in each case; what should cause the difference in results?

In one case a splendid success; in the other an utter failure. This is not an easy question for one to answer and I shall not make the attempt. Perhaps some of you present may be able to tell just what the trout require, what *quality* of water is best suited to them.

Many trout breeders, soon after the fry are hatched find it is impossible to retain them in the hatching boxes without great loss, but that if removed to pools out of doors a fair degree of success may be attained on the same water supply. In such cases I should be inclined to think that insufficient aeration was given the water in the first instance, for the mere fact that the troughs and fish were inclosed within a building would hardly cause them to suffer in any way; yet the fact of the water running through the air, and perhaps falling even a few inches from the hatching house to the pools may give the conditions necessary for the absorption of sufficient oxygen to support life in the second instance.

And yet I would not have you think that by the *quality* of the water I mean water containing sufficient oxygen or air only, for there is also something quite necessary besides this I firmly believe, much less understood, too often little appreciated, but of vital importance to the maintenance of the hatchery.

Young trout fry, in my opinion, are very sensitive to sudden changes and a change in the quality of the water, for even a short time, may result in a disastrous loss. If the water has once proven all right the greatest care ought to be taken that it remain so, that no surface water may get into the supply even for a day, that the temperature may not change suddenly by the inflow of melted snow or ice into the reservoir or spring. I believe that nine times out of ten where great losses of young fry have occurred, in a seemingly unaccountable manner, on streams which have been proven suitable for the rearing of this fish, it has been because the *quality* of the water has suddenly changed, which in most cases could have been prevented. If the water has been once proven right take every precaution that it be kept so. Protect your spring or reservoir perfectly. A water supply given all possible aeration by artificial means, may not be changed in quality, at least not in such a way as would be the case were it allowed to run exposed to the air and sun over soil and sand,

through weeds and water plants, where it might absorb nature's elixir of life, and perhaps give up some of the elements peculiar to itself when starting at the source.

An instance came to my notice some years ago where the water seemed greatly benefited by the growth of water plants. The trout were confined in a long pool of water coming from driven wells at one end of the pool. It was quite noticeable that the fish did not frequent the upper half or third of the pool, and were much thicker at the outlet than elsewhere. About one-quarter of the pool including the driven wells was screened off and water plants introduced, which grew rapidly, soon completely filling up that portion of the pond. A remarkable change was at once noticed in the behavior of the fish, which were now scattered quite evenly over the enclosure, showing that the water had undergone a change and become suited to their life.

Water from some springs and driven wells however *may* be found of the right quality from the start. I have seen trout living in ponds supplied from driven wells, where the supply came in at the bottom of the pool, and where there was no possible chance of aeration, except what little air might be absorbed at the surface. The water was surely of the right quality at the start for the small fry grew rapidly and were perfectly healthy in every way. At one time I remember (to illustrate the great difference in the quality of the water sometimes found in the same location) that I delivered a quantity of trout fry, late in June to a party in the northern part of Maine. I arrived at the gentleman's place late in the evening, and found that he had arranged a race-way with a suitable screen and that a good supply of water was flowing through from a clear, cold spring a few feet distant. I thought his arrangement perfect and, being rather tired having left the hatchery at daylight, went to my room at once.

Next morning upon inquiring how the fry were getting on I was surprised at being told that soon after being put into the pool they had commenced to die and only quick work saved a portion of them. Noticing that they were acting strangely and turning up, the purchaser who was a practical sort of man, made a temporary place for the fish in a box by knocking out the ends and covering with netting, then transferred the fry to this small

box placed in a stream of water not ten rods away, where they fully recovered, and when I saw them next forenoon were as lively and as smart, crowded thickly in their close quarters as they were, as when I started them on their journey the previous day. I doubt very much if an analysis of the waters from the spring and stream would have shown the vital difference in quality, proved beyond question upon trial.

Trout fry may be successfully hatched in water not possessing the quality necessary for future success, and while they may do well if transferred immediately to other streams more adapted to them, such may not be the case if retained under the first conditions until they become sickly and weak. Frequently have I heard someone exclaim: "I don't see what is the matter with my fry, they are feeding well but are dying fearfully!" Such may be the case when the greatest care is taken, the proper methods followed and the eggs from strong, healthy, vigorous, parent fish are used. I should like to mention a case where the hatchery and fittings formed one of the best arranged and complete plants I have ever seen. The water supply was from a spring reservoir with ample aeration. I was asked to visit this plant as the fry were dying in large numbers, and find a remedy for the trouble. As soon as possible I went to the hatchery. The hatch of brook trout that season was nearly 3,000,000, and the sight I saw on arrival made me shiver. The fish, just on the point of feeding, were dying by hundreds of thousands daily, and the bottom of the troughs were covered with dead although the man in charge assured me that all dead had been removed the day before. A most careful search failed to show anything wrong, the water was cold and splendid to drink, and all right for "it had been analyzed." Yet nevertheless I told the man that I did not believe trout fry would live in that water for the quality was not right for them. He replied that it must be for there was trout living the year round a quarter of a mile below, in the same stream. But future seasons proved that I was correct, no trout fry could be reared in that water and after a time the attempt to do so was abandoned. The methods followed were right—the quality of the water alone prevented a gratifying success.

I might mention several other cases of the almost total loss

of fry at hatcheries supplied with water of poor quality for this purpose, but I can suggest no way of proving the quality except by trial. Most likely if wild trout are known to inhabit certain waters during the year the conditions are suitable for their maintenance, and this should go a long way toward deciding on a suitable location for a hatchery. But one will see that although trout may be found in a stream during most months of the year, and living in a perfectly healthy condition, it does not follow that they were hatched in that particular water. It may be that somewhere the length of the brook a spring or tributary makes in where the spawn was given out by the parent trout, and while this smaller creek is of just the right quality for the young trout-let during the first few months of his life, perhaps the stream in which the larger trout was observed would prove very unsuitable. I think that it might be perfectly safe to say that where trout fry will live mature trout will live also, but many a failure will be made trying to rear fry where the larger fish will do fairly well. And lots of nice trout fry are wasted yearly by being planted in unsuitable places, where fingerlings or yearlings would live and grow. And almost everyone admits this, and still the same thing is done again and again.

Speaking of the planting of trout fry and fingerlings, I have never yet met anyone who advocated the planting of trout fry exclusively who was successful in rearing them much past the sac period. However, better to hatch a few million fry and scatter them broadcast into our waters than to do nothing; better still to raise some fry, some fingerlings, and plant them in an intelligent manner. And why cannot this be done? It can and should be done in every state having natural waters for this fish, for springs of the *right quality can be found* where the fish could be reared easily, for almost with neglect will they thrive and grow in waters just suited to the purpose. I feel that the idea I have tried to present should be nothing new to most of you present, but if generally thought of I would like to ask why it is that so many of our public hatcheries are maintained year after year on a water supply that makes success of rearing the fish impossible. True they may be hatched and planted when a few weeks old, but how much better to rear a portion of them for as many months, how much more gratifying to grow some of

them to the yearling age, for the mere hatching of millions of trout and retaining them during the yolk sac period only, is a small achievement compared with the raising of one-tenth of the number to a year old.

DISCUSSION OF MR. WOOD'S PAPER.

Mr. Titcomb: I wish to bring up one subject in connection with the paper for the consideration of the members, with the possibility that if it does not bring out discussion here, it may develop something in the form of a paper another year.

I have been experimenting with the eggs of the domesticated trout and the eggs of the wild trout. The eggs of the domestic trout are kept in spring water at these commercial hatcheries at a temperature of about 46 degrees, and the parent fish are kept in what you might call spring water in those drive-well hatcheries. In taking them to my hatchery and subjecting them to a temperature during the winter sometimes as low as 34 degrees, yes, even down to less than 33 degrees, (you can see the frost sparkling in the water) the eggs of the domesticated fish seem to be affected, while the eggs of the wild fish do not. Now I do not consider a water supply for a hatchery good which goes down to that extreme low temperature, but the question arises in my mind whether the domesticated trout reared in spring water will produce an egg which can be hatched as well in the cold water as the egg of the wild fish which is subjected to all temperatures of cold water, you might say. There is a point there that I have not been able to settle in my own mind, but I have suspected that trout which have been kept for a long time, or in different generations, in the warmer water throughout the winter, are not so well able to exist in the lower temperatures as the wild trout.

Mr. Clark: I take it from Mr. Wood's paper that it turns more upon the kind and quality of water. Of course, as you are aware, I have had considerable experience in trout culture and fish hatching for quite a number of years. Now I just want to give you my ideal of water for a hatchery: It is to have two kinds of water, as we have spring water, and either creek or lake water. In having the two, which range during the hatching season from 32 1-2 to 46 or 48 degrees, we are enabled by mixing the water to control and regulate the temperature, determining

to a great extent the period of incubation—especially with our lake trout—turning out the fry at such intervals as are convenient for distribution. In other words, fry from eggs of the same age do not all hatch at the same time, some being retarded by colder water. At Northville we can distribute fry for two months—holding them right in the hatchery—and never plant any with the umbilical sac completely absorbed.

Mr. Bower: I have been personally acquainted with Mr. Wood for some time and I believe he is one of the most intelligent and successful brook trout breeders in the country today, but I cannot agree with his conclusions as to the relative merits of planting fry and fingerlings. He rather intimates that the planting of fry is not very successful. I think there is no example in the whole United States of more successful trout planting than is presented in the state of Michigan. Over two-thirds of the trout streams in the state today, comprising some of the very best trout waters to be found anywhere, did not contain trout naturally, and their present standing as trout waters is due wholly to the planting of fry and not fingerlings. Now, I believe that if you plant a thousand yearlings or a thousand fingerlings you will get more adults than if you plant a thousand fry, but the point is right here: a thousand dollars' worth of fry, in my judgment, will produce a much greater number of adult fish than a thousand dollars' worth of fingerlings or yearlings, because there is some loss in rearing and there is also a heavy expense for food and care, and it costs twenty dollars to distribute a given number of yearlings to one dollar for an equal number of fry, so that you can plant such a vastly increased number of fry for the same amount of money that you will get much greater results for the money invested, presuming of course that the fry are properly planted, and that you must assume also with yearlings or fish of any age. So that, so far as the state of Michigan is concerned, we are thoroughly satisfied with fry planting and propose to continue it—it is no theory with us, we have the results to show what the planting of fry will do.

Mr. Clark: I see that Mr. Bower since he went with the Michigan Fish Commission, has become a great fry man. I have had arguments with some of the members of the Michigan

Fish Commission in regard to the fry and yearling matter and am on record in that respect. Neither at this time nor at any future time do I wish to take up the argument again, and especially with Mr. Bower. When Mr. Bower was with me he was one of the most rabid yearling men you ever saw, but I think Mr. Bower is all right, and he does believe in raising or partially rearing fish for planting, but not of course if you undertake to raise three or four million—that you can not do. But raise what you can, one hundred thousand, two hundred thousand or something of that kind, and I do believe that if you ever get lake trout established in many of the lakes in the state of Michigan you must rear them before you get them started. A brook trout two to four inches long is just as well able to take care of itself in the wild waters as when it is a year old, as everybody knows.

Mr. Bower: I just want to correct one impression. Mr. Clark says that when I was with the United States Fish Commission I was a rabid yearling man. Well, when I first commenced to hatch fish I was with Mr. Clark, and naturally drew my inspiration on fish matters from him and accepted his views and ideas as authority. But by and by when I began to read a little and learn a little by observation, and began to do a little thinking on my own account instead of allowing him to do my thinking for me, I began to modify my views, and long before I left the employ of the United States Commission, I was forced to admit that the planting of trout fry in Michigan streams produced excellent results. I was confronted with "a condition and not a theory." And I think Mr. Clark has changed his attitude very much, for he says when you want to plant three or four million fry it is all right, and that is exactly the point I would make. I say it is not true economy to undertake to raise five or ten million trout for planting, and that it is neither necessary or advisable, for your money will go a great deal further and the ultimate results will be much greater if the total cost of production and distribution is applied to fry instead of yearlings. This may not be universally true or true under all conditions and circumstances, but I am speaking of trout planting as it has come under my immediate observation. I really think Mr. Clark has come over to my way of thinking to a great extent himself.

Mr. Clark: There is not a single place in all the transac-

tions of the American Fisheries Society, or in any of the reports ever given by me to the United States Fish Commission, where I have ever written or said anything advocating the rearing of all the fish that are hatched—never.

The President: To fingerlings?

Mr. Clark: No, sir.

**DISCUSSION ON CARP.**

LED BY DR. S. P. BARTLETT.

Dr. Bartlett: From a practical standpoint I want to say to you that the United States Fish Commission builded a great deal wiser than it knew when it introduced carp in the waters of Illinois. I am here as representative of the United States Fish Commission, and I want to say to you that the waters of Illinois have proven more acceptable to carp than many of the other waters. I want to speak of that of which I know. The work of the Fish Commission depends entirely of course upon the money they have to run their business. It is getting to be practically a matter of dollars and cents, this Fish Commission business, and ought to be in the various states, but that is particularly true in Illinois. There is, perhaps, no one here that has been a stronger advocate in years gone by of protection than myself. I early made up my mind that any law the enforcement of which would kill a fisherman was next to gospel. I have changed my mind as to that considerably and believe now in propagation rather than protection. The last legislature of Illinois enacted laws which prohibit the taking of black bass, wall-eyed pike, etc., except with hook and line during the whole season. The carp on the other hand have been subject to a little more of the open season and are permitted to be caught more months in the year. I want to say to you briefly, however, and without giving you any reasons for it, because you all know what my reasons are, that the carp have produced in the State of Illinois more money than all other fish put together. That seems like a pretty hard statement to make, but it can be verified, and I want to say to you that there are more carp eaten on the hotel tables in the State of Illinois than any other fish. I have been served with "red snapper" which turned out to be carp. This cry against the carp is a great big humbug—it is an outrage—they are a good fish if you know how to cook them, but not so good if you don't know how. Most of you are men of leisure and like your black bass and whitefish, but what about the one dollar and ten cent a day man? He has

got to take carp. Illinois produced three quarters of a million of dollars in coarse fish last year. It would be as much as your life is worth to take a trip down to the Illinois river and tell the men there that carp is not a good thing. They would take you out and duck you gracefully into the river. More than one-half the towns on the Illinois river depend mostly for their existence on the fish industry, and considerably over two-thirds of the fish taken are carp. They grow anywhere and everywhere; they grow with the black bass, and the black bass are as plentiful as ever. Illinois can furnish one-half the black bass for stock in the United States, and yet there will be no diminution in quantity. We take just as many black bass with the hook and line this year as ever, while the carp are steadily on the increase. I have no patience with the newspaper talk that says that the carp are an enemy of the game fish. I do not believe anybody can prove it. I would like to hear it if it is so.

The carp in this state are accused of eating up all of the water plants,—in fact they have been accused of destroying the duck hunting in the states of Illinois and Indiana; they have been accused of almost every crime that fish can be accused of, but I do not believe any one can prove that the carp has ever been an enemy of the game fish or destroys its young or spawn. That is a pretty bold statement to make, but we have representatives here from all over the country, and I would like to hear what they have got to say on the subject. I hold the position that the United States government made the most practical plant of any of its plants when it planted carp in the muddy waters of such states as Illinois and Indiana. Twenty-five years of experience with people in the state of Illinois in the fish business has been up-hill work. I took the commission there when there was not a line on the statute books for the protection of fish, and I have followed it up until now, and previous to the introduction of the carp the muddy waters of Illinois were almost depleted of coarse fish, and today it is shipping to the east more and better fish than any other western state.

If I get a little bit extravagant, please attribute it to old age and forgetfulness. I do not wish to make any mistake or to exaggerate. I came here just to provoke the discussion on the carp.

Mr. Peabody: I am very glad that Dr. Bartlett, the friend of the carp, has introduced the subject, because we want to get some information in that line. I have run up against a number of very strong statements regarding the injury that carp do the fishing and shooting interests of Wisconsin. Only a day before this meeting began I attended a meeting of the directors of the Diana Shooting Club, and some of the directors stated emphatically that the carp were ruining our shooting, that they were eating up the wild rice and wild celery. One of the gentlemen said that the introduction of carp in Lake Koshkonong had destroyed the fishing of black bass and pike; that they roiled the waters and kept them in that state all the time, and that therefore the black bass and pike were driven out and did not propagate. I was in hopes that Mr. Ravenel would be here, because he has been the one defender of the carp at all these meetings, and I have always relied on him as to the value of the carp. He stated last year that the highest priced fish sold in New York during November and December was carp; that they came in with the turkey and were considered edible and valuable. Now some of the fish culturists here undoubtedly can give information that will be of value to us in this state especially as to just how much injury carp are and do, and if there are any gentlemen here who can answer the question, do they destroy the wild celery and the wild rice on such marshy ponds as are frequented by ducks, to the injury of the duck shooting, and do they roil the water so as to prevent the propagation of such game fish as bass and pike, and do they destroy the spawn, and do they go on the spawning beds of the black bass and destroy them, the information they give us will be very acceptable. Those are questions that I wish might be opened up here and discussed freely so that those of us who are not thoroughly posted on the subject may become so.

Mr. Townsend: It may be that the carp has been introduced in some places where it was not needed, where other kinds of fish were more important; it might not be advantageous to introduce the carp into the beautiful little lakes of Mr. Peabody's state; but there are many waters in this country teeming with carp, and people are finding out in many places that carp is a food fish. There is a market for carp in the big eastern cities and carp will sell there. They sometimes sell even for a high price; generally

they sell for a low price and are bought by poor people. There are many foreigners in our eastern cities that are steady consumers of carp, and take all that come to market. Carp go to market generally in good shape; they can be packed in ice in Illinois and will reach New York alive. If they are properly cooked they are very good fish.

Now we have in our waters a pretty good supply of coarse fishes. There is a tendency on the part of legislatures to cut off the commercial fisheries, to reserve more and more waters for hook and line fishing. This harvest of coarse fishes still remains. If the crop is not harvested it is lost. In the Illinois river they catch over 14,000,000 pounds of fish a year, chiefly carp and buffalo. That affords employment to 1,000 fishermen, who incidentally catch other fishes. It can be shown by statistics in the Fish Commission office that the yield of black bass in this great carp river, the Illinois river, has increased along with the carp. They now catch more bass than ever and the chances are that the young carp are food for the bass and the more predatory fishes.

The work of the net and seine fishermen in the Illinois river results in the capture of these coarse fishes, carp, buffalo, cat fish and dog fish, and the other fishes taken do not count for much. At the same time there are plenty of game fishes for those who want them for sport—such fishing is better than ever. So there are undoubtedly many waters in this country that will support the coarse food fishes and the fine game fishes without the one being an injury to the other. That may also be the case in Lake Erie where the carp catch is already important and marketable.

The dealers of Sandusky and Port Clinton are shipping all the carp they can get, not only to the eastern markets but to St. Louis, Cincinnati and Louisville.

On the Pacific coast the carp is abused just as much as it is elsewhere, and yet the Chinese of California are consuming carp and cat fish more than any other kind of fishes.

In New Jersey the carp have taken to living in the slightly brackish water, and most of the catch comes from those waters which lie between the more salty bay waters and the fresh waters. The carp there are in places where they appear to hurt nothing, and they are beginning to find their way to market. If I had a

big lake I should not hesitate to stock it with carp, and I should expect it to pay before very long.

I could go on talking about carp indefinitely. I do not know how much they roil the waters and how much they interfere with the feeding of wild ducks, but perhaps some of the other members do.

Mr. Clark: Mr. Townsend said that he did not think that the fishermen were yet catching many carp in Lake Erie, but last year in Maumee Bay, according to reports, carp were being caught by the ton, and I understand from Mr. J. N. Dewey that they are establishing there a system of keeping the carp when the market is low and putting them on the New York and Philadelphia markets when prices are high, also that they are making ponds along Maumee Bay and they catch the carp and hold them in the ponds until they wish to send them to market.

Mr. Townsend: It should be 3,000,000 pounds for Lake Erie—the figures were put too low.

Mr. Clark: I understand they do not catch so very many carp down in the lake along the islands, but the carp are there. In Detroit river during the last two years but few carp were caught, but it is possible that the carp will remain in great numbers in Lake Erie and will stay in such places as Maumee and Sandusky bays.

Dr. Parker: How is it up about the Flats?

Mr. Clark: They have some. There is some kicking about the carp.

The President: I can tell you about the Flats. I go up on the boat to the Flats twice a week, and every time I come down on the boat I get a damning from some bass fisher that claims the carp are destroying the bass fishing. But notwithstanding their claims the bass fishing on St. Clair Flats has been better during the last three years than at any time during fifteen years previous, and we have not planted any bass either. I can not account for it in any other way except that the environments of the carp and black bass are absolutely different. Black bass likes a clean, pure, sandy bottom, and the carp lives on a muddy, weedy bottom. I believe that the carp is a good thing in many waters where black bass thrive. I believe that the bass fishing at the

Flats has increased by reason of the food that young carp make for the bass, though he was not planted there. Millions of them are up there and you will see their backs sticking up out of the bullrushes. The only injurious thing that I believe they do is to destroy the food for the perch. Our perch fishing is not what it used to be, and the carp living up among the weeds and rushes cleans out the weeds at the bottom so that there is not as much vegetation there for food for the perch as there otherwise would be; so it is my judgment that the carp has injured our perch fishing but improved our bass fishing.

Mr. Titcomb: We all know that Mr. Bartlett is an authority on the carp; we also have here an authority on the bass. The question which I was going to ask and which Mr. Peabody did ask, was whether carp destroyed the spawn of bass. I say no, but I am not an authority. Now in Buffalo there is a strong fish and game association which obtained permission of the New York Fish Commission to seine the carp out of the river for the alleged reason that they destroyed the spawn of the bass, and when I passed through there they asked me to bring that question up at this meeting. Now, I should like to hear from Mr. Bartlett in answer to those questions which Mr. Peabody fired out so rapidly, he answering them as direct questions and as an authority, and I should like the views of others who have had experience with either the carp or bass, on that question, so that we can have a direct record on our minutes of these questions which have been asked directly and answered directly, in addition to the valuable information which we have been getting through the remarks of Mr. Townsend and yourself.

The President: Do the carp destroy the spawn of black bass?

Dr. Bartlett: You are placing upon my shoulders rather more honor than belongs to me. I am not an authority on the carp further than an intimate association with them during a number of years has given me the privilege of a good deal of observation.

Our Illinois river is really a series of lakes from one end to the other. The river itself is anywhere from seven to fifteen miles wide, and there is a considerable chain of lakes or low places on either side of the river, extending the whole length of

the river, and making an immense body of sluggish water. Interspersed are a large number of spring lakes. In order that I might know positively what amount of injury had been done by the introduction of the carp into the waters of the Illinois, I took occasion when carp were first brought upon the market and the hue and cry raised as to their destructive qualities, to open and be present while hundreds of carps were opened, to see if I could find in their stomachs anything that would indicate that they took the fry of other fish or spawn of other fish. I can not say that I have never found the spawn of other fish in their stomachs, but when I have found such spawn it has been of such a nature as led me to believe that it was such spawn as floated on the surface of the water, and that the carp took them in, in that sucking motion that he has, going around on the surface of the water.

So far as their eating up the growth in the water and destroying that is concerned, that is to some extent true, but I do not think that it is extensive enough to drive away the black bass from their breeding grounds or in any way interfere with them; and I think, Mr. President, you struck the key note exactly when you spoke of the increase of bass being due very largely to the immense supply of young fish for food. My work on the Illinois river is of a very peculiar nature, and I say this to show you why I gave you the figures that I did. Our work is simply saving these fish out of the overflow. There are thousands of acres of land planted to corn today where the land was water a few months ago, and thousands and thousands of acres more will dry up before the season is over. Into those places we go and take out the young fish, and a very careful estimate made after years of investigation, shows that not over fifteen per cent. of fine fish are taken out of those places under natural conditions. That is, go into a place that is not disturbed and eighty-five per cent. of the fish will be the coarser varieties and fifteen per cent. perhaps of the gamey varieties of fish, and not over one per cent of black bass. When we take into consideration the fact that is so well known of the voracious habits of the black bass, it shows an all-wise provision of nature to supply a very large quantity of coarse fish to feed the other fishes, and I believe as firmly as I am standing here that if the carp had not been

introduced in the state of Illinois, the buffalo having become almost extinct in our waters although it was once the great commercial fish that the bass would have been gradually taken out entirely from the list. As it is now, I want to repeat the statement that we have more black bass than ever, and our carp certainly have increased in a greater ratio than ever before.

Mr. Townsend: The figures prove that you have more black bass than you ever had.

Dr. Bartlett: Yes, sir. In our work for the United States Fish Commission we took this year from Barlow Lake, which would cover perhaps a mile in length and five hundred feet to a quarter of a mile in width, low and shallow, 51,000 black bass for distribution. Now that is in a mud hole, and there is no estimate as to the amount of carp that were removed at the same time and put into the rivers—they have been simply beyond computation.

As I said before, I have worked faithfully for carp all these years. For the first few years, fishermen would take the carp, open them up and dress them for sale the same as buffalo, and I had free access to the stomachs of the carp and failed to find to any considerable extent evidences that the carp has interfered with the spawn of other fishes. That is true at least for the muddy waters of Illinois that abound with plenty of other food for the carp. What might be the result in some of your cold water lakes in Wisconsin I can not say. The carp have a very peculiar value in that it is not necessary to dress them for shipment. The buffalo fish you might ice down as carefully as possible and within a very few hours he becomes soft, and therefore you have to dress the fish before shipment, and I believe about two-fifths is allowed for dressing. But the carp is shipped so to speak, with guts, feathers and all; he is taken right out of the water, covered with ice and frequently shows signs of life after being in a refrigerator car forty-eight to sixty hours, and every pound that is taken from the water by the fisherman is utilized to bring back so much per pound from the market.

It is only justice, however, to state that these carp are used in the east by a class of people who will not eat anything unless it is pretty nearly alive—Russian Jews, Poles, etc.

If there is any direct question that I can answer from personal observation I shall be very glad to do it.

Mr. Peabody: What do you know about the roiling of the water?

Dr. Bartlett: At certain seasons of the year they do make the water very roily. But we are to consider that our black bass are taken from waters that frequently have six or seven inches of mud at the bottom, and so it makes no difference.

Mr. Peabody: You do not think that that is important?

Dr. Bartlett: Yes, sir. There are a great many places in Illinois where the introduction of carp has proved a disadvantage. I know that to be a fact, in small spring lakes, take a lake of four or five acres, something of that kind.

Mr. Peabody: You would not think that a lake of one to three miles in size would be affected at all?

Dr. Bartlett: No, sir. My observation has been that the very best fly-fishing in the United States can be had upon the Illinois river today.

Mr. Titcomb: Is it not a base slander upon the bass to intimate that it would allow a carp to touch its spawn?

Dr. Bartlett: I should think so.

Mr. Bower: I think that where bass and carp inhabit the same water it is natural that the bass should increase. We have been hatching black bass for a number of seasons in ponds where we have an opportunity to observe their spawning operations from the time the male fish begins to prepare the bed until a good many days after the hatching is completed, and we know that the male bass guards the bed against all intruders. He will put up the stiffest kind of a fight against any animal that approaches the bed with a view of preying upon the spawn. There is no danger of a carp ever looting the spawn from a black bass bed. On the other hand I do not think the carp can retaliate against the bass in any way, shape or form. While the bass is preying on the carp, the carp can not come back at them in any way. In other words, in the interchange of hostilities between the two species, the bass gets the better of it at every stage of the proceedings, and I think it is a perfectly natural result that the bass should increase in waters where there is an abundance of carp.

Mr. Peabody: I would like to have Mr. Lydell's opinion on this subject.

Mr. Lydell: I never have known but a single instance where the carp has destroyed the spawn of the black bass, and I never knew of their destroying any other spawn. I have handled and opened what few carp were caught at the Detroit river, Belle Isle, Fisheries, during the last ten years, but never found any spawn in them.

Every one here seems to be friendly toward the carp, but a gentleman a while ago said he did not know how to cook them. I think it would be a good idea for this society to educate the people how to cook these carp. The only experience I have ever had in cooking carp I got from a German friend of mine at Mill Creek. He was a saloon keeper and had been at me for a number of years to get him some carp. Last spring I procured him two that weighed about four pounds apiece. They were cooked by his wife and I was invited down to dinner. I enjoyed the carp very much and I asked him how he cooked them. He said they were stuffed with sauer kraut and boiled in beer. (Great laughter).

Mr. Townsend: Just another point in this connection that may save discussion: We hear a great deal from sportsmen's clubs and from other sources as to how the carp can be exterminated. It can not be exterminated. It is like the English sparrow, it is here to stay. At a meeting of the American Ornithologists' Union a while ago, one of our foremost ornithologists stated that the European sparrow could not be exterminated in this country. I think it is the same with the carp. It is here to stay and we can not exterminate it any more than we can exterminate the green grass of the fields. I do not wish to pose as an advocate of the carp—I prefer other fish for myself—but I maintain that the carp has a place in good and regular standing in our big eastern markets, and I do not think that our great republic with its rapidly increasing population can afford to sneer at even so cheap a source of food.

Dr. Parker: I wish to say just a little bit in regard to this matter. The carp is the most omnivorous of all fishes. He is a hog and will eat everything. He will eat spawn if he gets it, but I do not think he will search it out. I believe, as the president

here has said, that the black bass will increase as a result of the presence of the carp, but we will see a depletion of the perch. As I said in my paper, you must go back to the vegetable for the rehabilitation of waters. If you destroy vegetation and the larvae, you destroy the minnows, and the perch have no minnows to feed on, unless they can eat the young of the carp, which they do not appear to do, but the black bass will eat the young of the carp and will thrive. Therefore you may look for an increase of the black bass, a decrease of the minnows, and also of those fish that feed upon the smaller minnows. I shall look for that in the balance of life that would naturally occur in a stream like the one described. That the carp do make the water roily goes without question. The old German (Hessel) who brought the first carp to this country told me in Washington that a clear carp pond would be an anomaly. They stir up the mud at the bottom of the stream, and live on the larval and vegetable life they find there. I believe then that the black bass will certainly increase with the carp unless the carp gets so numerous as to feed on the bass beds. Of course with a carp weighing twelve or fifteen pounds, an ordinary black bass weighing four or five pounds will not have much show.

Mr. Clark: Yes, he would.

Dr. Parker: He might whack away at him—they are not a very scary fish. I think that the carp has got more brains in his head than any other fish that swims. When I was on the commission over at Glenwood where they had the beds I tried time and again watching the carp that would be feeding on the edge of the pond there, by starting the slash-board, and every one of them would put right for the center of the stream, knowing at once where they were safe. I experimented a good deal with them and they are certainly the most wily fish I ever met.

Mr. Titcomb: I just want to make a statement about the bass, because this talk will be read not only with interest by absent members, but by sportsmen everywhere. The doctor intimated that a bass would not keep a twelve or fifteen pound carp off from the spawning bed. I want to make the statement, and if I am not correct I want to be corrected here, that the bass uses his dorsal fin as a weapon of attack and defense, and when a two

or three pound bass runs his dorsal fin against a fifteen or twenty pound carp, Mr. Carp will move off, if he is not dead.

General Bryant: I wish to make a friend of some of these friends of the carp, and get them to tell me their methods of catching, shipping and cooking him, and I would suggest that a paper be prepared next year upon that subject. The greatest trouble we have in some of our lakes in Wisconsin is that the carp have got in there. I do not know of a fisherman in Wisconsin that would catch one if he could, and I never heard of one being eaten either by anybody in the circle of my acquaintance. They were originally put into the muddy ponds, but in the high water they washed into the streams and have found their way into our lakes and are there by millions. They occupy the shallow sedge and muddy bottomed portions of the lakes, and I have often wished that somebody that knew how would start a method of catching them and shipping them, because I have heard so much said about it, and I always believe what the Illinois people say about the carp, and I do not question their veracity or their judgment at all, but the people in our section of the country are not educated up to the idea of appreciating the gospel according to St. Bartlett (applause and laughter) and other disciples and brethren of that faith. I am not questioning the truth of the gospel, but I am lamenting that it is not spread in our section. Within a radius of five miles of Madison there are billions of carp. Every fisherman sees them, curses them, and refuses to catch them. They seem to thrive there in the clear Wisconsin lake waters. There are many springs in part of these lakes, there are bars where the bass hatch and propagate and little sedgey inlets, indentations, bays, and sloughs, or whatever you may call them, where the sedge grows and vegetation springs up through the water, and there the carp are to be found in vast multitudes. Of course they can not be seined out from that kind of water. Now, what is the best way to catch them under such conditions in large enough quantities to ship? When you get them, what is the best way of cooking them? You tell us they are served in the restaurants in New York as a luxury, how can they be made so? If you can convince our brewers that to boil them in beer is the true way to prepare them, we will cer-

tainly have a strong auxiliary right hand to help us. (Applause).

Dr. Bartlett: While I am a strong advocate of the carp and their increase and value and all of that, yet a note of warning ought to be sounded in every state of the union as to legislation on the subject of the carp, and it should be of such a nature as to keep them down. If the people of the state of Illinois had had their way two years ago, the Illinois river and all the waters of the state would have been so full of carp as to have crowded out all of the other gamier varieties of fish. Carp increases so rapidly that legislation in all states ought to be had to allow them to take these coarse fish. We have thrown open the state of Illinois to the seining of these coarser fish.

To answer my friend's query as to cooking them, permit me to say that a carp taken out of the very muddiest of water, killed and bled as soon as taken out, laid in salt water over night, par-boiled and baked with proper sauce, can not be distinguished from the finest red snapper.

Dr. Parker: Another mode of preparation of carp is by smoking and curing them, as is done with halibut and sturgeon. A gentleman who had eaten them said to me he liked them better than halibut, though not quite so well as sturgeon, which he considered the finest smoked fish in the world.

Mr. Dunlap: In the line of General Bryant's suggestion I would like to move that Dr. Bartlett be requested to prepare a paper on the subject of carp, covering the subject as fully as possible, to be read at the meeting of the society a year from now, and I would say that the fish commission would be very glad to publish that paper in the Bulletin, as we all know there is very little literature on that subject; and I think from what we have heard that Dr. Bartlett is prepared to discuss the subject in all its phases.

(An inquiry was made as to the value of the carp as a game fish, that is as to their being any sport in getting him with hook and line).

The President: Yes. If you can get him, it is great sport. But the only way to do it is to take a piece of potato or dough and sink it to the bottom, and when you have got him on your hook there is no fish in the world equal to him for sport.

Dr. Parker: A kernel of corn will do very well for bait.

Dr. Bartlett: A man who has been many years in my employ tells me that the best bait for a carp is a dough ball incorporated with cotton to make it firm, and that a potato fried, but not too crisply, is the next best bait. I have seen three hundred and fifty people fishing at one time for carp with hook and line. These fish make a big fight because you cannot drown them.

Mr. Townsend: I brought with me a bundle of statistical sheets of the Mississippi region and the Great Lakes region, and if any members want them, they can have them.

Mr. Titcomb: I wish to suggest some topics for consideration at our next meeting. We get our calls for these meetings a short time beforehand and are busy and do not think just what we want to talk about. Now, on a recent trip I met a friend who joined the society at this meeting, Mr. Parker of the province of Quebec, and we traveled over thirty lakes in a canoe and caught trout in every one of them. One of those lakes was eight miles long and just teeming with trout. There seemed to be an abundance of food and the conditions were just the same as in the other lakes, and yet none of those trout that we caught there would weigh over one-third of a pound, and the average would be about a fourth of a pound. The next lake might give you trout which would average a pound, some of them going as high as four pounds. Passing on to another lake you would get trout the average of which as taken with the fly would be half a pound, and another lake three-quarters. You could pass on to the last lake and pick up trout at every cast in six to ten inches of water with the waves a foot high so that the fish would jump right out of the water and land on the sand if they did not happen to catch your fly, and the fish would run about three to a pound. Now the question which I have raised and put in the form of a topic is given here this way:

"Given the same kind of water, food, etc., the same environment so far as appears from a superficial examination, why such a great variation in the growth and average size of adult trout in various lakes?"

There is one other question which comes up very often and which I think has never been answered and I would like to see

a paper on it if anyone has an opportunity to study into the subject, namely:

"The cause for variation in color of flesh of speckled trout from any given body of water."

Of course the general variation relates to different bodies of water, but frequently you can take fish right out of the same pool, or without moving your boat from a certain spot, which have a distinctly white meat, a light pink meat, and a rich salmon colored flesh. The general answer ordinarily given to that question is "food and environment," but it does not answer the question when you can take those fish with three colors of flesh out of a space ten feet in diameter.

Mr. Peabody: Mr. Lydell is a specialist in bass culture and I have had the question asked me and the statement made boldly that the large mouthed bass cast their spawn in the weeds and against the weeds, and do not make a bed like the small mouthed bass; and if that question can be answered authoritatively, I think it would be a source of satisfaction to a great many who are interested in bass culture and in bass fishing.

Mr. Lydell: This last season our big mouth bass spawned on several different kinds of beds, but in no instance have I known them to spawn without first cleaning away the vegetation and getting to the roots or the weeds. Some of their eggs were found on the weeds adjoining the beds cleaned off. This year they also spawned on prepared gravel beds, and on other artificial beds having various materials on the surface and imbedded in the cement mixture of which the beds were made, such as Spanish moss, cocoanut shreds, sea grass and excelsior.

The President: But where is the natural spawning bed of the wild big-mouthed bass?

Mr. Lydell: It seems to be on roots of the different weeds that grow in the lakes around the shores. The bass there also spawned on roots and bark that were in the bottom of the pond, and also on lily roots in the pond that is prepared at that station for large-mouthed bass. This pond had been set out to pond lilies, and they cleaned the roots off under the lilies and spawned on them. So I say I think the large-mouthed bass will spawn on most anything, but they prefer the grass roots.

The President: That is the natural spawning bed of the wild bass.

Mr. Lydell: Yes. In one pond that we have, almost invariably they have cleaned off the dirt from the roots carefully around the shore, and spawned, but in the pond that I mentioned where they were confined they did not have enough room to spawn on those places, and so they cleaned off the roots, etc., as I have mentioned.

Mr. Peabody: In your opinion will the large-mouthed bass guard their spawn beds as pertinaciously as the small-mouthed bass do?

Mr. Lydell: I do not think so. I do not think they are as voracious or as great fighters as the small-mouthed variety. I think they will give up easier and let something else destroy their bed easier than the small-mouthed bass. The question was raised here a few minutes ago regarding the fighting qualities of the small-mouthed bass. I know of one small-mouthed bass that guarded its bed until it died right on the bed fighting ten other small-mouthed bass, and some of them a great deal larger than he was, but he kept them off for a day and one night until they killed him.

The President: I have made this assertion, that no carp ever got hold of an egg of a black bass unless Mr. Bass had been first taken off from that spawning bed. I do not believe there is such a thing as a carp ever having devoured a single egg from a black bass bed where the black bass was on the bed. Of course if the beds are deserted that is different, but as long as the bass is alive and guarding the bed, no carp ever got a single egg.

Dr. Parker: My observation regarding the spawning habits of the large-mouthed bass is that in the natural state they prefer the lily roots, but in their absence they will take the roots of grass or anything, but they like the large spread of the lily root.

Mr. Bower: Mr. Ravenel stated at the last meeting that in the southern states the big-mouthed bass spawned on sand, gravel, clay and in fact almost everywhere, but that they preferred lily roots.

Dr. Bartlett: The state of Illinois presents exactly that feature in the spawning of bass—you will find their nests everywhere from gravel to simple mud. Fifty-one thousand small

black bass were taken from a place in a pond where there is no gravel, but a black loam mud running from twelve to twenty inches deep.

Mr. Peabody: Is it your conviction that the large-mouthed bass do not protect their spawn or young?

Mr. Lydell: I say they do, unless a large number of other fish drive them away. They will give up easier than the small-mouthed bass, but they will stay with their fry longer than the small-mouthed bass. I have had them guarding their fry until they were one and a quarter inches long, and unless the water becomes very roily they will not desert their fry, but if it does become roily they will.

Mr. Nevin: I saw hundreds of them spawn this year and not one of them protected their spawn at all. The large-mouthed bass do not protect their young but the small-mouthed bass will.

Mr. Lydell: We had some large-mouthed bass that spawned and deserted their spawn in a couple of days, but on examination we found that the eggs were blasted, and the bass undoubtedly knew that.

Mr. Nevin: What percentage of eggs do you find impregnated among bass?

Mr. Lydell: I think close to ninety-five per cent., when they do fertilize, is fertilized, among large-mouthed bass.

Mr. Nevin: How much among the small-mouthed bass?

Mr. Lydell: The small-mouthed bass, some of them nearly 100 per cent., and I have had them fertilize as low as ten per cent.

Mr. Nevin: With our beds this spring they did not impregnate forty per cent.

Mr. Lydell: I have had that same condition.

Mr. Bower: I think it was stated at the last meeting that carp brought ten to twelve cents a pound. I would like some further information on that point.

Mr. Peabody: The statement has been made that during the season carp has brought twenty-five cents per pound.

Mr. Bower: On Lake Erie in the month of June they get down as low as \$10 a ton. That is all the fishermen get out of them. I have clippings here that show that statement to be true. They have hard work to find a market for them at \$10 a ton. Is

that state of things due to the fact that it is the wrong season, or are the Illinois fish of a better quality.

Dr. Bartlett: The carp do not bring the prices I have given at all seasons of the year, but along the Illinois river they undertake to catch the carp and hold them until the best season to sell them, and they are placed in ponds for that purpose. On Clear lake on the Illinois river a man has an enclosure of ten to twelve acres, and these fish are put in a pen as it were and kept until the proper time to market them.

Mr. Clark: As I have casually looked over the market reports in the Fishing Gazette, I do not think I ever saw carp quoted above three cents. I have looked at the market reports on whitefish, bass and everything else, and if I recollect rightly, from two to three cents is the quotation on carp.

Dr. Bartlett: I can show you quotations at six and seven cents.

Mr. S. W. Downing, Put-in-Bay, O.: The reports show the price at Ft. Clinton to be forty to sixty cents a cwt. One firm informed me that the day before I was there they had bought and shipped 28 tons of carp. The same firm last year bought and shipped 700 tons, and another firm there I believe did a still larger business, which would make something like 1,500 tons shipped from Ft. Clinton alone. So I think the figures given are altogether too small.

Mr. Clark: I would like to ask how those prices, forty to sixty cents a hundred, compare with herring prices in the fall?

Mr. Downing: A little less than now.

Mr. Clark: I mean in the fall catch, how do they compare?

Mr. Downing: A little less than the herring, but just about the same.

Mr. Clark: The herring is considered quite a fish in the great lakes.

Mr. Peabody: Regarding the price of carp I had a conversation with Mr. Ravenel last summer, and I think his point very well taken. I have known peaches to sell in the Chicago market for five cents a basket, and I have known them to sell for \$5, and it depends entirely on the season and the conditions. Now Mr. Ravenel says that the proper time to eat carp is about Thanksgiving time and a little later; the carp then has value in New

York and brings a high price, but that it is marketed at all seasons of the year, and as it is a good shipping fish it is shipped at all times, and the market is very poor for it during the months when it is more easily caught, and I think all this has something to do with the variance in the estimate of the market value of carp.

General Bryant: How is the quality of the carp affected by the water it is in? Where it is in sloughs of dead and sluggish water and becomes very warm in the summer time, is the flesh softened and does it become flabby as other fish do, or does it keep firm?

Dr. Bartlett: It goes through pretty solid.

General Bryant: The water that it is in with us is of an excellent quality and not subject to impurity.

Dr. Bartlett: You would have a good fish all the time. Carp taken out of your waters and shipped east ought to bring good prices.

Mr. Nevin: How would carp be if smoked?

Dr. Bartlett: Good.

Mr. Lydell: Are the bass in your river large or small-mouthed?

Dr. Bartlett: All large-mouthed.

Mr. Lydell: As to bass guarding their beds, I will tell you of a case of a bass guarding two beds, or rather guarding the same bed twice. After mating and spawning and when the fry were hatched and ready to swim up, I set a circular screen around the bed, but the old bass did not desert—he stayed there and stood guard around the screen. I fed him there every day with minnows, and after the fry were removed and the screen was taken away, this same bass mated there again and got a second crop of eggs on the bed, and after the second crop of fry and the screen were removed, he still continued on guard over about thirty fry that I purposely left there.

Mr. Nevin: Was it a large or small-mouthed bass?

Mr. Lydell: A small-mouthed bass.

Mr. Townsend: The statistics which are on exhibition show the shipments of carp, 3,000,000 pounds for Lake Erie amounting to \$50,000 for 1899.

## CONCERNING FISH LAWS IN ILLINOIS.

Urbana, Ill., June 28, 1901.

S. Bower, Esq.,

Secretary American Fisheries Society,

Detroit, Mich.

My Dear Sir: Replying to your esteemed favor of the 19th inst., requesting me to prepare a paper for the coming meeting, I beg to express my sincere regret that circumstances render it impossible for me to comply. Just at this moment my undivided time and attention are devoted necessarily to the reorganization of our warden system, in view of the fact that our newly amended law for the encouragement of the propagation of fish and for their protection approved May 11 last, goes into effect on July 1, prox. This Warden system has for some time been in a very much demoralized condition, in part from the inaptitude of the appointees, and in a greater sense from the fact that the statute made no provision for remuneration for the services rendered.

Incidentally, however, it may be of interest, in default of a formally prepared paper, if I convey to you some idea of the improved situation under which we expect to find ourselves under the operation of the amended law in Illinois. To begin with, the law will now empower the commissioners to compensate the wardens when on errands of duty. But above all the new law has an ample provision for the seizure and destruction of such devices for taking fish as are declared by the act to be unlawful. This will have a most salutary effect on all violators of the law. Hitherto it has been a practical impossibility to secure convictions in our river towns. Local sympathy ran almost uniformly with the fishermen, in consequence of which justice, juries and state's attorneys seemed impelled to override evidence, and the result was that the rights of the people were ignored and the statutes practically nullified, so that the destruction of the fish supply went on almost without let or hindrance. This exasperating state of affairs naturally demoralized the Warden service. It was useless to send a Warden to make an arrest, because the failure to impose, and collect a fine merely operated to bring the law still farther into contempt. The commission was therefore constrained to abandon prosecutions in localities where conditions such as these existed.

These exigencies inspired the commission to seek a remedy in the legislature by having introduced a new measure, the one to which I have already referred as coming into effect July 1 prox., a measure much better calculated to cope with the situation. After

convincing the members of the utility of and the necessity for such legislation as the measure asked, but little difficulty was experienced in securing its passage, to take effect as already stated. One of its wisest provisions in my opinion, and the one that will yield the best results, is that which prohibits fishing within 400 feet of any dam between the 15th day of April and the 15th day of June. I mention here a single instance that came under my personal observation illustrating the destructiveness of the practice which this provision is intended to cure. It was at the Waldron dam, in the Kankakee river where one rod in a single day took 135 bass, most of them females. Can there be anything in the way of protective legislation more productive of good results in the perpetuation of our game fishes, than the positive prohibition of this barbarous method of taking the parent fish while on their journey seeking a place to propagate their young? We are simply endeavoring to bring the law to the assistance of these pretty and useful denizens of the water in their efforts to perpetuate their species for the benefit of mankind. The destruction of game fish by indiscriminate angling from April 15 to June 15 below dams is the fruitful cause of the depletion of many of our inland streams. In a word, it is the paramount evil that has retarded the increase of game fishes in our waters.

Fish leave their winter quarters, ascend the streams early in the spring, and they find their progress retarded by various obstructions, dams being the chief and most formidable. Before these obstructions, the fish congregate by thousands, unable to proceed further. A few succeed in getting ahead by means of fishways, where such provisions are made; but the great body of them are at the mercy of the unscrupulous angler who never leaves the spot so long as a poor, helpless, hungry denizen of the water will consent to be landed in his creel. He goes home with his enormous catch, and ignorantly gloats over the destruction of millions of fishes which future generations ought to enjoy. He is unable to see an inch ahead of his nose, and to recognize the fact that he is taking out of the water the multiplied and multiplying progeny of these helpless creatures, the stock which nature is striving to supply for the years to come.

I ought to mention that the stipulated limitation here mentioned—the sixty days between April 15 and June 15—is a compromise. It was the desire of the commission to make the limitation cover the entire time from April 1 to July 1; but the opposition was so determined that it was deemed expedient to agree to the sixty day limitation, rather than incur the risk of having the bill defeated in toto. It is wise to recognize the fact that measures of a drastic character must be brought before the people by degrees.

Another feature of our new law which we regard as of vital importance is the provision which prohibits the taking of bass with

any device other than hook and line, thus making the angler the sole beneficiary of this species.

Presumably, if the sportsmen of Illinois could have the opportunity to legislate upon the question of the use of nets or seines, there would be a practically unanimous vote in favor of abolishing their use entirely. But what would be the result of that? In Illinois there are thousands of people who earn their bread almost entirely by taking the coarse fishes that the angler despises. These people would be practically thrown out of employment, and many of the river towns would feel the effects of losing a considerable portion of their population. Thousands of dollars that are invested in tackle and boats would lie and rot on the banks, and vast sums of money that come from eastern markets in the purchase of these coarse fishes would cease to pour in, for fish that refuse to be ensnared by the anglers' lure can only be taken by net or seine.

It is evident that the industry in these coarse fishes must be fostered. It is a matter of no small commercial importance. Over 14,000,000 pounds of this class of fish were taken last year within the jurisdiction of Illinois. The laboring man, earning a dollar a day, cannot pay 25 cents a pound for the finer fish taken by the angler. Carp, the much abused Cyprinoid, that has not had a word of praise from any mortal since its introduction in this continent—vilified by every sporting paper from Maine to California, a nightmare for the angler, and a general all-around Jonah—will yet loom up like a Phoenix in the piscatorial horizon as the future cheap food supply for the generations that are to come. Permit me to set down here a little anecdote illustrating my opinion of the carp as a food fish, and showing that the tirade against it is mostly prejudice. Some two years ago, my esteemed colleague Col. S. P. Bartlett and myself were at Springfield endeavoring to convince the legislature that it was necessary for the Fish Commission to have a new boat, because the old one lacked capacity for the accomplishment of the work laid out for the year then ensuing. We thought we were meeting with fair success, until one of the members arose and cried out, in a ponderous voice: "That's the man," pointing to Col. Bartlett, "who introduced those infernal Dutch Carp that kill all other fish, and aren't fit for a dog to eat." We supposed we were lost; but the bill was only on its second reading, and we had another chance. Col. Bartlett sent to Meredosia for a twenty-pound Carp, turned it over to the chef at the hotel and gave instructions to have it well prepared and put on the menu as "Red-snapper." The instructions were followed and it came on in an artistic manner. When dinner was served, not less than twenty of the members called for "Red-snapper" from two to three times. After they discovered they had eaten Carp, our bill passed without a dissenting vote. We never heard anything more in the way of tirade against Carp during that session. I give this anecdote to show that it takes a connoisseur at

least to distinguish Carp when properly prepared. Suppose we grant that it was a mistake to introduce these fishes into our waters, is it not better to take them also under the protection of our laws, to regard them as a real money producer and a source of cheap food for a large class of our people, since all this can be so readily accomplished without detriment to our game fishes?

In a word now, our new law gives the market-fisherman an opportunity to realize his revenues from August 1 to April 15 in the rivers used for commercial navigation only; all other streams and lakes will be left for the angler. With the proper enforcement of the amended law of which I have spoken, there is every reason to expect that the coarse fishes will remain abundant in our waters, and that the game fishes will increase from year to year. Thus I trust you will be able to get a faint glimpse of the fact that we are striving to do a good work in Illinois, in preserving and enlarging the means which God and nature have placed in our hands for supplying an inexpensive and healthful food for the tables of the masses and a dainty for the tables of the rich and the well-to-do. In this important work we shall progress the more the better the people—the source of our authority—understand the methods by which and the ends to which our efforts are directed.

Wishing you a pleasant and very profitable meeting, I am,

Very sincerely yours,

NAT. H. COHEN,

President Illinois Fish Commission.

**STURGEON HATCHING IN THE LAKE CHAMPLAIN BASIN.\***

BY LIVINGSTON STONE.

Somewhat of the mystery formerly surrounding the taking and fertilizing of sturgeon eggs on a large scale has been removed, only to be replaced by the appearance of difficulties which seem even now to be almost insurmountable. Only three years ago, it was a mystery why the net fishermen, while they caught plenty of parent sturgeon with eggs in all stages of maturity, never caught any with wholly ripe eggs in them. Now that we know the reason of this to be that ripe sturgeon caught in nets, throw all their eggs in their efforts to liberate themselves, the difficulty arises of securing the parent fish *before they throw their eggs*.

We adopted various devices, this spring, to accomplish this object. We set trap nets in the two rivers and also in the lake, but the sturgeon would not go into the trap nets. We set gill nets in various places in both the Lamoille and the Missisquoi rivers, and we had these nets overhauled every hour, night and day. We also overhauled and examined all the parent sturgeon in the pens every day, but somehow most of the ripe fish eluded us in one way or another before their eggs could be secured. In some instances, even when we had a night guard on duty, parent fish caught at night by the fishermen, and put in confinement were stolen before morning, the high price paid for caviare sturgeon (i. e., female sturgeon with nearly ripe eggs in them) being a sufficient incentive to poachers to incur unusual risks in stealing them. At other times, ripe fish gilled at night and safely conveyed to the pens by the fishermen would spawn in confinement before morning, thus eluding the spawn takers. At another time,—this was on the 13th of May,—a large ripe female sturgeon of nearly a hundred pounds in weight was found

\* The operations referred to in this paper were conducted under the auspices of the United States Fish Commission, by the writer, very ably assisted by Mr. Myron Green, in Northwestern Vermont, in the Missisquoi River and the Lamoille River, tributaries of Lake Champlain, and in the Lake itself.

in our Missisquoi River pens. There were three able bodied men present to handle the fish besides the writer, who stood by, ready with the spawning pan. The fish was no sooner lifted from the dip net by the men on the stripping platform, than with two terrific blows with tail right and left, she sent her eggs flying across the platform to the distance of a rod or two, in the meantime struggling so violently that it required the combined efforts of the three men to hold her. Finally having subsided to a degree of comparative quietness, the few remaining eggs in her—perhaps 20,000—were taken, but though these were successfully hatched, the stripping of the fish was, of course, a failure, as not more than four per cent. of the eggs were taken. At still another time, three large female sturgeon, supposed to be fully ripe were caught. On holding the fish up by the tail, the eggs sagged in the abdomen as with a fully ripe salmon, and in order to ensure our not losing these eggs as others had been previously lost, two of these fish were knocked in the head and instantly killed, when, to the great dismay of the spawn takers, the eggs were found after all, not to be sufficiently mature to be fertilized. To avoid a repetition of this risk, the third fish, which appeared to be the least ripe of all, was put in confinement to ensure the further ripening of her eggs. This fish spawned that very night.

The above instances illustrate how elusive and disappointing the sturgeon were, when an attempt was made to get their eggs, and now many difficulties presented themselves, even after their mysterious character had been removed.

The difficulties did not prove wholly insurmountable, however. All the fishing for spawning sturgeon had been done, this year, on the Missisquoi with nets. On the Lamoille, we encountered something different. Near the south bank of that river, about four miles from its mouth, and half a mile from the West Milton postoffice, Vermont, is a place known to the residents of that neighborhood as the "Sturgeon Hole." Here the main body of the river rushes through a rocky gorge not over twenty or thirty feet wide, with precipitous walls of solid rock on each side. Just below the gorge is a hole about forty-five feet deep, apparently shaped somewhat like a boat, in which the spawning sturgeon collect, usually very soon after their appearance at the mouth of the river, but most probably when the water reaches

the right temperature for spawning. The water is too deep to spear the fish here and nets cannot be used, but the sturgeon are taken by twitching them up with hooks. We watched this hole night and day, after the appearance of the sturgeon at the mouth of the river, and obtained many breeders from the "Hole" after they had begun to collect in it, twenty-seven being caught on the 22nd of May, the temperature of the water being 68 degrees F. These were all or nearly all ripe males, but on the afternoon of the 23d of May too entirely ripe females were hooked up. The fish not struggling violently at first, the men stopped the flow of eggs by stuffing their handkerchiefs into the vent. The fish were then towed across the river, where the males had been secured, and were instantly killed by being knocked in the head. Their eggs were taken and treated like pike perch eggs, as to impregnating, mixing with milt, rinsing, etc.

In the meantime, a rude hatchery had been constructed on the north bank of the Lamoille, with a battery of twenty-two jars, a short distance from the Sturgeon Hole. The eggs now obtained were all placed in the jars, where they appeared to do finely. The next day, the writer took a few thousand over to the hatchery at Swanton, where they subsequently hatched out without difficulty. The remainder were left at the temporary hatchery on the Lamoille. The hatching water for our battery here was obtained from a spring brook, which rose, I think, about a mile to the north. Before locating the hatchery at this point, Mr. Green and the writer had many discussions as to whether the water in the brook might not get too cold for the sturgeon eggs. There was no other supply obtainable, however, with the limited means at our disposal. It was "Hobson's choice,"—take that or nothing—so we took the hatching water from the brook. For a time, the weather remained fairly warm, and the eggs did well. It was found on examination of the eggs, when the form of the fish first appeared in the embryo, that nearly ninety per cent. of the eggs were impregnated. Then there came a frost, one morning, and the water dropped to 50 degrees F. The next night, there came another frost, and the water fell to 45 degrees F., and then the sturgeon eggs all died. It was a bitter disappointment. We had struggled against great discouragements, and now we thought we were on the eve of a

great success, instead of which we were on the eve of a great failure.

A consignment of eggs which had been in the meantime sent to Cape Vincent Station met with the same fate, the water of the St. Lawrence used at this station being also comparatively cold at this season.

We afterwards discovered a spawning ground of the sturgeon on the shore of Lake Champlain, a short distance south of the mouth of the Lamoille. Here is a well-protected bay, with a beach sloping very gradually out to deep water. In the shallow waters of this bay, in water not over three feet deep, strange to say, the sturgeon come to spawn in the month of June. Here we found them spawning in plain sight from the shore. We set trap nets and gill nets here, and caught many ripe males and several ripe females, the first week in June, but did not succeed in collecting any impregnated eggs.

I may add here that the sturgeon eggs that we took averaged 850 to the fluid ounce. They are apparently amorphous as to shape, and of a dull and dirty color, but this appearance is given them by a cobwebby film which surrounds each egg. The film can be easily separated from the eggs by squeezing the egg out of it with the fingers, and the egg is then seen to be spherical, clear, and crystalline like other fish eggs, and not very different in size from white fish eggs, though perhaps somewhat larger.

The eggs come very easily from the parent fish when they are ripe. They are somewhat glutinous, but if taken from a freshly caught fish, they are no more so than pike perch eggs, and if treated as pike perch eggs are when taken, they will give no trouble in sticking together, and will easily hatch out eighty per cent. or ninety per cent. of healthy fry. The eggs that were taken at the Swanton hatchery hatched in seven days in an average temperature of 65 degrees F. Their mobility was so much less than that of pike perch eggs that it took a stream of water running through a three-eighth inch rubber tube with about a six foot pressure to keep them in motion in the hatching jars. The young fry are hardy and very active, but if they are to be confined in tanks or troughs, the screening must be very tight, as they can work themselves through an extremely small crevice.

Allow me to state in conclusion, as I have already done, in

my annual report to the United States Commissioner of Fish and Fisheries, that the following points in regard to Lake Sturgeon and Sturgeon hatching may be considered as pretty well established:

1. The Lake Sturgeon go up the tributary rivers of Lake Champlain to spawn. They ascend different rivers at different times, the time for each river appearing to be determined by the temperature of the water. The river that the spawning sturgeon of Lake Champlain first ascend is the Missisquoi, in the extreme northwestern corner of Vermont. They go up this river very soon after the pike perch have finished spawning in the river, which is usually the latter part of April. The largest number of ripe fish appeared about May 13th. The spawning sturgeon were all out of the river by May 20th.

The Lake Champlain sturgeon ascend the Lamoille, a Vermont river which flows into the lake about thirty miles south of the Missisquoi, somewhat later. This year their first appearance at the mouth of this river was about the middle of May; and they collected in the Sturgeon Hole in the greatest numbers for spawning on the 23d of May. They had all left the river by the end of May.

2. The Lake Sturgeon spawn in the shallow waters of the lake in June. At least, there is a spawning bed in the shallow water of the bay just south of the mouth of the Lamoille, where the sturgeon come to deposit their eggs. Parent fish collect in this bay to spawn about two weeks later than they are found in their greatest numbers in the Sturgeon Hole of the Lamoille. The largest number of ripe ones was observed on June 4th. By June 15th, all had left the spawning grounds of the bay.

3. As far as we have observed, the Lake Sturgeon will not spawn until the water reaches a temperature of 60 degrees F. In our experience on both lake and river, we have never found sturgeon spawning in colder water than this. We are consequently led to believe that they *require* water at or above 60 degrees F., though of course, this must be accepted only as an inference.

4. The Lake Sturgeon spawn at various periods later than they do in the bay just mentioned, as is evidenced by the fact that

we caught parent fish in June with eggs that would not have been ripe for a fortnight, and others with eggs that would not have ripened for a month or longer.

5. The parent sturgeon do not seem to ripen their eggs well in confinement, unless they are *very nearly ripe* when captured. We found that the eggs of the fish that we kept in our pens caked together and otherwise became very poor, if the fish were too long confined, and the eggs would probably not have been susceptible to impregnation even if they had ripened enough to be extruded from the fish. This point must not be accepted yet as conclusive, for it is quite probable, I think, that means will be found eventually for keeping sturgeon in captivity without injuring their eggs till they are ready to spawn.

The spawning season at the various spawning grounds of the Lake Sturgeon is very short. They are doubtless spawning somewhere all summer, but at any specified spawning ground, I do not believe that they are in the act of spawning over three or four days. I have set wide limits in this paper to the period that the spawning sturgeon remain on their spawning beds, in order to be on the safe side, but I think that on a more thorough investigation, these limits will be very much narrowed.

7. Unless some device has been adopted for forcibly retaining the eggs in the parent sturgeon, it seems to be almost useless to attempt to strip a ripe fish after it has once been lifted out of the water alive. A few seconds of time and a few powerful strokes of the tail are sufficient to throw all their eggs to the four winds. If the eggs are ripe, it must be ascertained before the fish is taken from the water, or the instant it is lifted from the water. The vent can then be plugged, the fish put in a straight-jacket, and the eggs taken without difficulty. We adopted various ways of "plugging" the parent sturgeon, but after all, the most effective way was to stuff a handkerchief instantly into the vent, and keep it there. If this is done quickly enough it will be a success. If something of the kind is not done or if the ripe sturgeon is given any time to struggle, if only for a few seconds, the eggs will be lost.

8. The eggs of the Lake Sturgeon, once they are taken, are easily impregnated. It has frequently, in fact almost always

happened, that when a straggling ripe female has been found, or when the females have been ripened in confinement, ripe males for fertilizing the eggs could not be found. On the other hand, if the ripe females are captured during the three or four days during which they are collected on the spawning beds, ripe males will be found in abundance. When we caught the ripe females in the Lamoille "Sturgeon Hole," we could have taken a quart of milt from the males, if it had been necessary.

9. The eggs of the Lake Sturgeon are easily hatched. Any of the hatching jars in use for pike perch and white fish are suitable for the purpose. Run a stream of water through the jars with sufficient pressure to keep the eggs in healthy motion, and they will hatch without trouble and without much loss. It is highly probable that eighty per cent or ninety per cent. of sturgeon eggs taken under favorable conditions will be hatched in the future.

**NEW PENNSYLVANIA LAWS FOR THE PROTECTION  
OF FOOD FISH.**

BY DR. BUSHROD WASHINGTON JAMES, (A. M., LL. D.),  
Of Pennsylvania.

For a number of years the Pennsylvania Fish Commissioners and the Pennsylvania Fish Protective Association have been working in harmony to induce the Legislature to aid them by law in protecting food fish from destruction. Time after time bills have been laid before our law makers, and some have been passed, which aimed at guarding the fish from depredation.

The United States Fish Commission has spent large sums of money and much scientific labor in propagating and distributing the most desirable kinds of fish in numberless streams and rivers along either coast as well as in the interior states. Yet their efforts have been but partially successful because of the persistence of fishermen and other sportsmen who will in season and out of season, catch the half grown and even very young fry of those which have been carefully hatched and planted for future benefit. The two societies named have used their utmost endeavor to aid in keeping the few laws that have been passed but they felt their inefficiency because of the imperfection of the Legislation.

Several times they have jointly tried to have a certain set of laws passed which they codified with most careful consideration of every point requisite to secure the much desired results. But until this year efforts have been almost in vain, notwithstanding the earnest personal attention given by several members of the Board of Fish Commission and of our society. The writer was for years chairman of the committee appointed to formulate a new code of laws and to carry them through. When he became president of the Pennsylvania Fish Protective Association he appointed another committee on Legislation of which Mr. Howard F. Chase is chairman. This committee has acted with a joint committee from the Board of State Fish Commissioners, Mr. William E. Meehan, chairman. It is with satisfaction therefore that he finds the laws actually passed and made available

for the future protection of the beautiful and delicious denizens of our noble rivers and lovely mountain streams.

The act, for obvious reasons, does not embrace the border waters of Lake Erie or the Delaware River, for all other water ways in the state it goes into effect immediately. It embraces the following:

Section 1. These are game fish: Salmon, all species of trout, black and Oswego bass, crappie, grass, strawberry, white and rock bass, blue pike, pike-perch or Susquehanna salmon, pike, pickerel, sunfish and muscallonge. These are called food fish: Shad, white fish, herring, lake herring, cisco, alewife, sturgeon and striped bass or rock fish.

Section 2. Game fish may be caught only with rod, hook and line or hand line not having more than three hooks. Food fish only with devices specifically named. Fine, \$25.

Section 3. Open season for brook trout, April 15th to July 31st; lake trout, January 1st to September 1st; black bass, sunfish, all species of bass except striped bass, pike-perch or Susquehanna salmon, pike, pickerel and muscallonge, June 15th to February 15th. Fine, \$10 for each fish. (Note.—Striped bass or rock fish, shad and herring, may be caught with rod, hook and line or trolling line at any time).

Section 4. Must not catch or kill white rock or strawberry bass less than five inches in length; brook trout, less than six inches; black bass, seven inches; lake trout, Oswego bass, striped bass or rock fish, blue pike, pike-perch or Susquehanna salmon, pike, pickerel and muscallonge, less than nine inches in length. Fine, \$10 for each fish.

Section 5. Unlawful to catch more than fifty brook trout in one day. Fine, \$10 for each fish over that number.

Among the greatest enemies to the protection of the fish were nets, which scooped up all kinds and all ages of the fish, from which the large ones were selected and the others either thrown away or wasted as bait for larger fish in deeper streams. Eel pots also were used to the detriment of the young fish. The following laws concerning them, if properly enforced will be very beneficial to the planted fry:

#### THE USE OF NETS AND OTHER DEVICES.

Section 6. Eel pots made of wicker work, five feet long, opening two and one-half inches wide, lawful except in trout streams.

Section 7. Lawful to use dip nets, spanning five feet, two inch mesh, except in trout streams, during March, April, May, October,

November and December, for carp, suckers, catfish and eels. Other fish to be returned. Penalty, \$10 each fish and forfeiture of nets, etc.

Section 8. Lawful to use fyke nets, without wings, except in trout streams, not set to openings in dams or to wing walls, for carp, suckers, catfish and eels, in March, April, May, October, November and December, and in shad streams only in March, April and May. Each net must have metal tag with name and residence of owner. Other fish to be returned. Fine, \$25 for illegal placing, \$10 for each fish unlawfully kept and forfeiture of nets illegally set.

Section 9. Lawful to use seines, mesh  $1\frac{1}{2}$  inch, except in trout streams and natural lakes, for carp, catfish, suckers and eels, provided bond amount of \$200 be first given Fish Commission, other fish to be returned. Fine, \$100 and six months' imprisonment, also forfeiture nets, boats, etc.

Section 10. Lawful to fish for herring, shad, striped bass or rock fish and sturgeon with seines or other nets, from January 1st to June 20th, except between Saturday sunset and Sunday midnight. Meshes for herring nets,  $2\frac{1}{4}$  inches; for shad and striped bass or rock fish, 4 inches, and sturgeon,  $10\frac{1}{2}$  inches. No net to be set or fastened at both ends. Fine, \$100 and forfeiture of nets, boats, etc.

Section 11. Lawful to use lay-out lines from sunset to sunrise, except in trout streams, for catfish, eels, carp and suckers. In trout streams, with one hook only, each line to have tag bearing name and residence of owner. Line must be on bottom. Cut or dead bait only. Other fish than those named to be returned. Possession of other fish by operator of lay-out or single line, illegal. Fine, \$25 and forfeiture of lines.

Section 12. Unlawful to kill young sturgeon. Fine, \$20 each fish.

Another manner of obtaining large quantities of fish is by screens, fish ways, or other devices for catching and detaining them on their way along the rivers either to their spawning grounds or on their outward course to deep water. The law relating to these is made quite plain. We quote,

#### FISHWAYS, SCREENS AND OBSTRUCTIONS.

Section 13. Fish Commissioners may compel erection of fish ways in all dams, and collect cost from owners. Also fine \$50 a month.

Section 14. Fish Commission may order net or screens across race ways or flumes to keep fish from entering. Fine, \$50, and Commission may place such nets and collect cost.

Section 15. No fishing except with rod, hook and line within one-fourth of a mile of a fish way, and no obstruction to be placed

which will prevent free passage of fish. Fine, \$100 and forfeiture of all devices used.

Section 16. All obstructions to fish ways to be removed by Commissioners, and builders fined \$100.

There was a great necessity for regulating the sale of game fish and for specifying the times at which artificially bred fish were to be sold, as some proprietors of fish ponds had the idea that they could control the matter without legal interference, hence the importance of the following sections:

#### REGULATING SALE OF GAME FISH.

Section 17. Unlawful to purchase, sell or offer for sale any dead game or food fish, except during open season and six days thereafter. Fine, \$10 for each fish.

Section 18. Unlawful for any proprietor, manager, club or agent of any market, hotel, boarding house, eating house, saloon, to buy, sell or expose for sale any speckled trout, or to employ any one to catch or fish for trout, provided that nothing in the section shall be construed to prevent during the open season, any person or company from selling trout or speckled trout bred and raised artificially. Fine \$25 for each offense.

Section 19. Lawful for any person, company or corporation engaged in the cultivation of trout to sell trout at any time of year for stocking purposes only on condition that the fish when transported are accompanied by a certificate of Justice of the Peace certifying that said trout are raised by the owners for artificial propagation only. But no company may sell trout for food purposes during close season. Persons transporting or selling shall be subject to a fine of \$100.

Section 20. Fish caught unlawfully must be returned unharmed to the water. Fine \$10 for each fish.

Another particular difficulty meeting the fish hatcheries and private fish ponds is the injury done by trespassing. It would be well if the law relating to the trespasser were posted in plain view of the fisheries and hatching places. It reads as follows:

#### IN RELATION TO TRESPASS.

Section 21. Unlawful to trespass with intent to fish on a State fish hatchery, or on property of corporation operating hatchery not for profit, provided no screens are maintained to prevent free passage of fish, also such property must be indicated by signs. Persons may not fish on such property from roadways or bridges, and domestic fowls trespassing may be killed after five days' notice to owners. Penalty for trespassing on such land \$25.

We think it doubtful if the public have ever thoroughly understood that the Fish Commission is a public institution created for the general benefit and not for the community of sporting men as it has been believed by a few who denied the importance of any legislation concerning fish and eels. The sections here quoted put the matter plainly:

DISTRIBUTION OF FISH AND PUBLIC WATERS.

Section 22. Unlawful to apply for or to be concerned in applying for self or another any game or food fish for waters in which the public are not allowed to fish. Eggs exempted, also fish and eggs for schools. Fine \$25.

Section 23. Free waters to comprise those declared navigable by the acts of Assembly or public by common law, and such others as are made public by owners by grant or usage.

Section 24. The Fish Commissioners may give preference in distributing fish to waters in lands owned by the state.

Section 25. Whenever fish are planted in waters on written application of owners or lessees such waters are declared open to the public for fishing purposes thereafter. Provided, that the section shall not be construed to permit any person fishing in such waters from the banks without permission of owners or lessees; small spring runs tributary to trout streams not included.

At the time of the introduction of German Carp into our fishing streams it was supposed to be a food fish innocent of any very pernicious habits, but experience has shown that the larger fish are not agreeable for food and they do unquestionably destroy, or devour the young of our far more desirable fish. Old fishermen along the borders of our inland rivers or creeks bewail the presence of the "great rough fish." They point to the coffee colored waters of the once silvery streams and say that they never were so until the carp were put there. One old man on the Perkiomen said: "There aint no fishin' any more; what the cussed carp don't eat he frightens away with his lashin' on the bottom of the creek." Whether this be true or not the turbid waters must have some cause for the new feature in their coloring. The Fish Commission has doubtless solved the problem as the following sections would denote:

GERMAN CARP UNLAWFUL FISH.

Section 26. Unlawful to fish with any poison or explosive, and no explosive shall be used in waters except for engineering pur-

poses, after written permission is obtained from proper national, state, city or county official. Fine, \$100 and imprisonment for six months.

Section 27. Unlawful to plant German carp or use this fish for bait. Fine, \$100.

Section 28. Unlawful to plant pike, pickerel, black bass or carnivorous fish in waters inhabited by trout without consent of owners and Fish Commissioners. Fine, \$100.

Section 29. Bait fish may be caught by minnow nets for angling or scientific purposes, and game fish during close season by owners of water for stocking other waters; provided such netting is done under supervision of the Commissioners or authorized representatives. Commissioners may also remove injurious fish with nets at any time.

There are times in which valuable food fish fall off in quantity with the danger of extinction if some means is not provided for their defense. The following law was formulated to meet such emergency:

OTHER FISH THAN THOSE SPECIFICALLY NAMED.

Section 30. The Fish Commission may declare by public proclamation a close season in any fish not specifically named in the act; provided such close season shall not prevail for more than three years. Fine for catching such fish in close season, \$25.

There are fishes in our rivers that are regarded as good for food but which are not included in the species that are under the direct protection of the society. These are free to be taken at any time considered seasonable, providing the protected varieties are left unmolested, it being stated in a former section of this act that any so taken shall be returned to the water. The section relating to free fishing is as follows:

Section 31. Fish not specifically named in the act as game or food fish may be taken at any time of the year with rod, hook and line or hand line not having more than three hooks; provided this does not conflict with the conditions of the previous section.

Section 32. The prohibitions and penalties in the act do not apply to the Delaware river or Lake Erie

Having thus made plain the laws regulating the catching of the food fishes which have been considered of sufficient importance to require the attention of such a body of men as the government now upholds, it was deemed advisable to form laws to

guide such officers as were required for the maintenance of these codified laws, therefore the following laws were adopted showing clearly the officers and their duties; we quote in full:

#### DUTIES OF FISH WARDENS AND OTHERS.

Section 33. Fish Commissioners, Fish Wardens, Sheriffs, Deputy Sheriffs and constables, special officers or any peace officers are authorized and commanded to destroy any device used contrary to law, and persons placing devices or fishing illegally may be arrested without warrants. Arrests may be made on Sunday and proceeded against as soon as possible thereafter.

Section 34. Any Sheriff, Deputy Sheriff, constable or any peace officer who shall refuse or neglect to proceed with sufficient force to remove and destroy illegal devices shall be deemed guilty of misdemeanor and subject to a fine of \$500.

Section 35. Persons interfering with any officer in discharge of his duty shall be subject to a fine of \$100, or be imprisoned not less than three months, or both, at the discretion of the Magistrate of the court.

#### DISPOSITION OF FINES.

Section 36. One-half of every fine collected recovered, to be paid to informer, the other half to the Fish Commission for fish propagation and protection.

Section 37. Possession of fishes out of season, or illegal size, or illegal nets, considered prima facie evidence of guilt.

Section 38. Any Justice of the Peace, Alderman or Magistrate, upon information or complaint made by affidavit, is authorized and required to issue his warrant, to cause such person or persons to be arrested and brought before such Magistrate, etc., who shall hear and determine the guilt or innocence of the accused, who, if convicted, shall be sentenced to pay fines or penalties, and in case the defendant or defendants neglect to pay at once, the defendant or defendants shall be sentenced to undergo imprisonment in the county jail for the period of one day for each dollar of fine so imposed and unpaid.

Section 39. The Fish Commission may close a newly stocked stream or lake for three years, on notice given in at least two newspapers of the county, any person fishing such waters subject to a fine of \$10 for each fish taken.

Section 40. All actions must be brought within one year.

#### FISH COMMISSIONERS.

Section 41-42. The Governor shall appoint six Fish Commissioners, who care for the fish cultural and protective work of the

state. They have power to enforce the provisions of the act, to appoint fish wardens and issue bulletins on fish cultural matters.

Section 43. There shall be not more than twelve regular wardens, at such salary as Commissioners may determine, who shall be subject to duty at all time and in any part of the state. One of these shall be a chief, with headquarters at Harrisburg.

Section 44. Wardens, Sheriffs and constables are given the right of search.

Section 45. No salary for wardens shall in the aggregate exceed the amount appropriated by the state specifically for this purpose.

Section 46. Special Wardens, without salary, may be appointed on the application of any properly organized fish protective association or associations with established hatching houses.

Section 47. All wardens are subject to removal at any time by the Fish Commissioners.

These laws and regulations, of course, have been codified and passed into active service in and for the State of Pennsylvania. But it may be possible that other states will view them with favor and follow with equally beneficial legislation. This subject, it will be remembered, was under consideration some years ago and a committee was formed with the hope of inducing the numerous states to adopt uniform laws on this important subject.

**BROOK TROUT NOTES.**

BY W. T. THOMPSON.

Our country is peculiarly fortunate in the great area of its trout waters. There are but few localities, excepting the extreme south and some of the prairie states which cannot boast of one or more suitable streams.

Varieties and sub-varieties are scarcely less numerous than are the waters. Each section has its aspirant for the popular favor, some favorite son as it were, whose peculiar claims are always loyally, if not consistently paraded for public view. They also have the "Brook Trout." You will find it the same story everywhere, always: the "Brook Trout" and—some other trout. The uninitiated finally concludes there are but two divisions: the "Brook Trout" and the *other* trout.

I wish to call attention to two points mentioned in my paper last year:

1. *Early feeding of fry.* Fry should always be taught to feed before they can swim, when you see them begin to withdraw from the huddling, wriggling mass and take up a separate and individual existence, scurrying independently around the bottom of the trough, you may know that, in response to nature's demands, they are looking for food. Give it to them, no after care can make amends for neglect now. They require but little at a time. Give it to them in homeopathic doses. Don't foul your troughs. Brook Trout, in common with some other members of the Salmonidae will begin to feed from one to three weeks, varying with the water temperatures, before they can swim. Try it. Try it yourself. Don't entrust this most important work to some one simply because he can't do anything else satisfactorily. Mr. J. W. Titcomb, our former president, has a most delightfully dry vein of humor which he taps on proper occasion as when he remarked last summer during his illustrated lecture at Woods Hole, in explanation of a certain lantern slide: "We once had a very lazy man at St. Johnsbury. I had heard that it took a lazy man to feed fish, so I tried him." Adding with a

tinge of pathos in his voice: "He isn't with us now." The tone, supplementing the picture, told the whole story.

2. *Care of weaklings.* Quite recently I talked on this subject with a fish culturist, who bears a most excellent reputation for careful, conscientious work. He lamented the difficulty and tediousness of feeding the weaklings who had fallen back to the tail screen. Said he: "I can't feed them there satisfactorily so I take them up with a net and carry them to the head end before I feed the trough." "But are they not back at the tail by the next feed time?" "Yes, that's true, they are and it takes considerable labor to repeat the operation each time. I suppose Supt. Blank thinks I consume a great deal of unnecessary time in so doing, but I can't feed them with any measure of success otherwise." Troughs need constant thinning, when you have these weaklings in the net, why not transfer them to a different trough along with other similar unfortunates thereby really combining in this one act the three operations of thinning, sorting and caring for the weaklings. Give these latter several salt baths to cure the frayed and fungused fins and heal the congested gills. A little extra attention in feeding and you soon have a trough of average fry out of your hospital. Visitors frequently comment on the almost entire absence of fish at the lower end of our troughs. Yet up to the present time, we have done no sorting except by this simple method. Always do your thinning from the tail end. Leave your strong head-enders together. Feeding is greatly facilitated as well as simplified. We rarely consume thirty minutes in thoroughly feeding about 125,000 trout and salmon fry, now being carried to the fingerling stage, and occupying some thirty troughs and ten ponds.

*Transferring from trough to pond.* One great drawback that the young fish culturist experiences is the difficulty of finding recent text-books. Our authorities are largely out of date, their methods obsolete. Quoting from a standard authority: "The rearing ponds are stocked gradually, 500 to 1,000 being placed in the pond and trained to take food before more are added, as that number can generally find enough food to subsist upon until they learn to take artificial food. When they have been accustomed to hand feeding, another 1,000 fish are added

and in about ten days 2,000 more, this practice being continued until the pond is stocked with the desired number." From another venerable authority on the same subject, we learn that: "A certain fashionable woman owned a most wonderful lap dog, A most *remarkable* creature, possessed of every virtue of his kind save, save one—Alas! poor Fido had a long silky tail while fashion decreed that only bob-tails should be worn. Necessity was ever the mother of invention. Early one summer morning, Fido's neighbors were aroused from their slumber and startled by the most heartrending yelps and howls, then all was quiet. Fido was not in evidence that day. The next morning the yelps and howls were repeated, curiosity was aroused. Neither mistress nor dog appeared. The strange noises were repeated daily for a week or more. Then the mystery was solved. Fido had a *bob tail!* In response to inquiries, his fond mistress tearfully said: "It would hurt the poor little dear so to take it all off at once, so I just cut off a tiny little piece each morning." Summing up the consensus of authority quoted, it would seem to be established beyond question that had the whole ten thousand dogs been placed in the pond at once, the fish's tail would have been bobbed in infinitely less time and with less suffering on the part of the fish culturist. Do you know, I firmly believe that our fish cultural authorities are as much opposed to revision as an old time blue Presbyterian.

*When will the harvest be?* No question is more frequently asked than: "How many years does it require for these little fellows to get big enough to catch?" It is both a reasonable and practical one, and yet it is one that is rather difficult to answer definitely. It is one I ask of the members of this society. "How long does it require to grow a fish of angling size from fry?" Two years? Three years? In New Hampshire they will tell you "One year." Qualifying it however by adding: "Under favorable conditions." For two years past the sporting papers as well as the local press of New England have been full of the great loss of trout throughout that section caused by the unprecedented drouths of 1899 and 1900. Many stated that there would be no brook fishing within three years, others took even a more gloomy view claiming that it would require a greater

period of time simply to replace the brood stock. Never was there a more favorable time to thoroughly test the value of planting and at the same time to answer the above question by a practical demonstration. In the spring of 1900, the United States Fish Commission made heavy plantings of large, vigorous, well fed fry from one to two inches long, followed by a summer distribution of two to four inch fish and winding up in November and December with trout some of them even then above the usual five and six inch limits. This work had been done so quietly that few other than those actually engaged in the distribution and planting were aware of this new factor. Hitherto nothing but unfed fry had been planted. The arrival of the open season scarcely created a ripple of excitement amongst the anglers. Conditions and results though are best described in the accompanying letter from Mr. W. H. Beasom, a prominent citizen and former mayor of Nashua, as well as an ardent sportsman.

Nashua, N. H., July 1st, 1900.

Mr. W. T. Thompson, Nashua, N. H.

Dear Sir:—For the past twenty-five years, with possibly three or four exceptions, I have fished for trout in the brooks around this city. During this period the number of anglers has increased to such an extent, that about ten or twelve years ago, I came to the conclusion that nothing except regular and intelligent restocking of the brooks would save the trout from extermination—or at least diminishing the supply to such an extent as to make angling a doubtful luxury. In company with a friend, Mr. Geo. F. Andrews, I applied for fry from the state hatchery, they were distributed and each year since I have with Mr. Andrews or others planted from 15,000 to 25,000 annually. If I had any doubts as to the benefits of restocking—which I did not—they would have been removed by the results of this season's catch. The seasons of 1899 and 1900 were extremely dry ones, some small brooks drying up for nearly their whole course, while others were dry for quite long intervals—as I found when woodcock shooting in October, I did not see any dead trout, but it is fair to assume that many died as our trout are not good tree climbers. During 1899 the streams had a good supply of fry planted—but as I recollect it, the fishing of 1900 was below the average—or at least not very good. In the summer of 1900 (Note, Aug. 8), the United States Government Hatchery had a quantity of fish measuring from two to four inches in length which I had the pleasure to assist in planting in nearby streams. All previous plantings had been fry about one inch long. The fall of 1900 was even

dryer than 1899 and fishermen were apprehensive of results this year. To our surprise and pleasure, the fishing has been better this season than for years past, especially as to size of fish. A larger number of trout weighing from one-half to one pound has come under my notice than for years—while a large number running from six to nine inches have been caught. In fact any one with a knowledge of fishing can get a few of fair size nearly any day. In speaking of a well known and much fished brook, one of our oldest anglers said: "I have known and fished that brook for twenty years and never knew the fishing to be better than it is today." Now one swallow doesn't make a summer—but my personal opinion is that this extra fishing after unfavorable conditions is largely, if not entirely, due to the planting of well grown hardy fish instead of the fry usually distributed. To be sure fry were planted as well, and I firmly believe fry planting to be of value, but if we could have from 25 to 33 per cent. of the total of fry in well fed trout from two to four and one-half inches long, I firmly believe the results would be more substantial in every way.

Yours truly,

(Signed).

W. H. BEASOM.

Possibly some of you may not agree with Mr. Beasom in his conclusions, may not think them sufficiently warranted from the evidence. It is true this is largely circumstantial. I admit that brook trout yearlings weighing one-half pound and upwards sound somewhat like fish stories. Yet with his long experience as an angler, his thorough knowledge of the conditions coupled with his general reputation as a conservative man, his opinion is certainly worthy of careful consideration.

This is a matter on which it is exceedingly hard to obtain positive proof; the difficulty of successfully marking fry when liberated, the impossibility of determining the age of wild fish when caught, but add to our perplexity. Still there are conditions under which even these perplexing questions admit of a definite solution. Such an occasion is detailed in the accompanying letter from Mr. Nathaniel Wentworth, president of the New Hampshire Fish and Game Commission, a director of this society and a man equally well known across the border as in his own New England as an expert with rod and gun.

Hudson Center, N. H., July 1st, 1901.

Dear Mr. Thompson:—Yours of June 28th, at hand. The pond I stocked last fall with fingerlings was made by building a dam across a ravine. There had never been a trout or fish of any kind in the

stream above the dam before. We have some trout in this pond from this planting that will measure ten inches. I am sure they will average seven inches. They are nicely colored and very fat, showing there must be plenty of food for them in the pond as we have not fed them.

Our brooks in the southern part of the state as you are aware have been partially dry the last three summers. Notwithstanding this there have been some good strings of trout caught in the two last seasons. There is no question but what these trout are the result of the fingerlings planted from the United States Hatchery at Nashua.

Many of our brooks are infested with every enemy the trout has, from the mud pickerel down, and it is almost impossible for fry to escape them. It is impossible to get men to plant fry properly as a rule. I would give more for 1,000 fingerlings like what we got from you, than for 50,000 fry. Sincerely yours,

N. WENTWORTH.

It is not possible to rear in captivity with restricted range and somewhat unnatural food such magnificent specimens as are the gifts of nature in her more kindly moods. Still, with our long New England winters and cold waters, we have three ponds of yearlings at Nashua, reserved for brood stock, which on July 15 showed an average weight in the different ponds of from 6 to 6.4 oz. each and with numerous specimens weighing one-half pound and upwards and 10 inches or more in length which we would be pleased to show to the members of the society. An embalmed fish is but a poor illustration; but, as the mountain will not come to Mohammed, Mohammed must go to the mountain.

The brook trout holds a unique position amongst fishes, somehow this "speckled beauty" has a most peculiar and tender place in our affections. He is associated in memory with the old home, the cool sparkling brook, the ferns and the wild flowers, the singing birds and the shady nook, childhood's friends, and the dear old home folks. Ah! me, those were happy days indeed. In memory we live them all over again, by the uncertain light we can see a youth appear and softly close the door behind him. A faint glow lights up the east, he lingers a moment on the stoop. The glory of the morning possesses his soul. The cool, moist air comes up from the meadows, rich with the perfumes of the new mown hay and lingers caressingly on

the brow flushed by the hasty preparations. Passing down through the orchard, his heart is thrilled by the morning hymn of the warbler, unconsciously the pure melody of the boy's heart bursts forth in answering strains. The robin, in the cherry tree, ceases his labors for a brief moment, to listen, his archly poised head disclosing a breast ruby red, as though dyed with the stolen fruit. A sharp tramp over the hills to the brook, then—the stealthy approach, the light cast, the quick rush, the long struggle, the light rod bends like a reed, every nerve quivers. It is over, he lies in the wet grass, gasping for breath, his heaving sides, richly colored and gaily marked glisten in the morning light. The fiercely gleaming eye tells of a spirit unsubdued, captive but unconquered. The wild joy of the conquest passes away leaving only a feeling of admiration. Isn't he a noble fellow! The creator *could* have made a better fish, but—in His wisdom—He did not.

## **MAINE AND THE SPORTSMAN.**

(Accompanied by Lantern Slides).

BY A. H. DINSMORE.

With the anticipation of much pleasure in the task, I began in the fall of 1900 to collect material for a set of lantern slides, to be presented before this meeting, illustrating the fish and game interests of my native state. My transfer from Maine to South Dakota early in the present season interrupted me in the work of securing original negatives and obliged me to rely largely on other sources for this material. The resulting slides while not all I had hoped to make them fairly represent the great fish and game regions of the state.

It is moreover, a keen disappointment to me that I am unable to be present and describe to you the scenes which have been so familiar to me from boyhood.

It is impossible for one unacquainted with the extensive forests and the great lake systems of Maine, so easily reached from the eastern and central states, to realize the vast importance of its fish and game interests. It is estimated that the visiting sportsmen annually leave in the state \$4,000,000. This vast sum is paid cheerfully for the wholesome outdoor life that comes with the click of the reel, the swish of the line, the purring of the water, cut by the bow of the canoe, and the inspiration of the camp fire after the day's chase.

For the comfort and convenience of this army of sportsmen places of entertainment are provided in every part of the state, ranging from the little isolated log camp to the great modern hotel. Eighteen hundred men are licensed as guides by the state, who furnish canoes and camp outfits. Many of these men have small camps, well equipped, in favorable localities which are placed at the disposal of their patrons. To guard against forest fires, all non-resident sportsmen wishing to camp on wild land in Maine are required to secure the services of one of these men. The guides are required under penalty of fine and loss of license to co-operate with the wardens in protecting the fish and game

from poachers, and to report to the commissioners the number of people guided and the amount of fish taken and game killed.

Along with all the usual facilities for the accommodation of summer company, including the best of New England farm house board, the Maine Yankee has some schemes all his own which are worth noticing. The camps of the Messrs. Young and Buxton at Lake Onawa illustrate one of these schemes, and their management is spoken of in the highest terms by those who have been entertained there. Their property consists of small, cosy, log sleeping camps or lodges clustered around a large, log dining camp with suitable kitchen annex. Good fishing and hunting can be had close by the home camps which are located but a few minutes' walk from telegraph, express and postoffice and railway station. For the benefit of those who wish to penetrate further into the wilderness, camps are located, equipped and provisioned on the principal ponds and streams within a radius of twenty-five miles.

The camps of the Debsconeag Fish and Game club are operated on a similar plan, except that in the end they aim to serve club members only. At present, however, they are open to the public. These camps are situated at First Debsconeag Lake, fourteen miles by steamer and four by canoe, from Norcross on the Bangor and Aroostook Railroad. Forty lakes and streams may be fished from then and the hunting is as good as the state affords.

Another special outing that is very popular in Maine is the steamer trip on Moosehead Lake. Steamboats accomodating from six to twenty persons may be chartered at prices ranging from \$10.00 to \$15.00 per day. They are fitted with everything necessary for cooking and furnished with good berths. A party may live on one of these boats as long as they choose, go where they wish on a lake forty miles long by fifteen to twenty wide, and be absolutely certain of good fishing in season. The fishing is undoubtedly responsible for a much larger influx of visitors, and of far greater value to the citizens of the state, than the hunting. While good bass, pickerel and perch fishing may be had, trout and salmon are the great drawing cards.

Brook trout are found throughout the lake regions and here reach their maximum size. Lake trout, or togue, as they are

called in Maine, are taken in many of the lakes, but are generally little esteemed by either resident or non-resident sportsmen. The food quality of this fish varies greatly in different localities.

As is well known, Maine is the home of the landlocked salmon, although now found in many sections of the state, it was originally confined to four localities, viz. The Sebago waters, near Portland, the waters forming the Union river in Hancock county, those forming the Sebec river in Piscataquis county, and the Schoodic lakes, on the eastern boundary. The Sebago and Union river waters furnish the largest fish but they are much more numerous in the Schoodic and Sebec regions. At Cowyard Falls on Shippond stream, between Onawa and Sebec lakes, one may at almost any time during the summer and early fall months count salmon by the hundred as they attempt to scale the falls. For convenience the slides have been arranged in such a manner as to divide the state into three sections as follows:

1. The Rangeley and Dead river region. This country lying in the western part of the state is easily reached from Boston and affords some of the finest trout and salmon fishing to be found. It contains many lakes, large and small, and is popular as a summer resort. The hunting is also excellent.

2. The Bangor and Aroostook region, including the great northern counties of the state. It is of vast extent, containing 15,000 square miles. In it lie a thousand lakes and ponds, all well stocked with trout or salmon or both.

One of the most attractive features of this great North Land is the opportunity afforded by this network of lakes, ponds and streams for extended canoe trips. The so called West Branch trip from Moosehead lake down the West Branch of the Penobscot river is 125 miles long, while the Allagash trip from Moosehead lake to Van Buren is 200 miles. This trip may be extended down the St. John's river to the city of St. John in New Brunswick.

3. The Washington county region reached by the "Sunrise Route," the new Washington county railroad. This section was opened to the non-resident sportsman in 1899 by the completion of this road. It lies in the south-eastern corner of the state, and contains the famous Schoodic salmon waters.

The trout and salmon waters of Maine, with a few exceptions, are open to the non-resident sportsman from May 1st to October 1st, and the catch limited to twenty-five pounds at any one time. The best fishing is secured immediately after the ice leaves the lakes, and every spring thousands of fishermen all over the country await the telegram that tells them the lakes are clear and sport may begin.

As many of the slides relate to the game interests of the state a brief reference seems necessary.

Almost all the fishing resorts become game resorts after the 1st of October. For weeks, much of the time extra cars are necessary to move the quantities of game which the non-residents take out of the state with them. It is estimated that 15,000 deer are killed in Maine annually. About 200 moose are each year shipped out of the Bangor and Aroostook region alone.

Do you ask how the game can maintain its numbers against such slaughter? The answer is first, wise protective laws stringently enforced; second, the great timber sections back from the main water ways where the hunter seldom penetrates. These regions are natural breeding grounds where the game is seldom molested. Of course deer and moose have almost no natural enemies now. The wolf was exterminated many years ago, and the bear and wild cats are not numerous enough to do serious damage.

The increase of deer in Maine during the last two decades has been nothing short of marvelous. I can remember when it was a very remarkable event for a deer to be seen or heard of near my home at Dover. Now there are thousands of them within a radius of twenty-five miles and they are frequently seen on the outskirts of the village.

Moose, too, are slowly but surely on the gain. The illegal slaughter of moose by wealthy sportsmen—so called—who make no pretense to honor in such matters and care nothing for a fine, has been stopped by the imposition of a short jail sentence.

We will now have the lights turned off and fancy ourselves for a time in that great game land of the east, the state of Maine.

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Active .....	291
Honorary .....	54
Corresponding .....	25
<hr/>	
Total membership .....	370

# CONSTITUTION.

(As amended to date).

## ARTICLE I.

### NAME AND OBJECTS.

The name of this Society shall be American Fisheries Society. Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all the interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

## ARTICLE II.

### MEMBERS.

Any person shall, upon a two-thirds vote and the payment of one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar per year, after the first year and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of \$15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

## ARTICLE III.

### OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding

Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

#### ARTICLE IV.

##### MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

#### ARTICLE V.

##### CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.